DOCTORAL THESIS

Gender diversity and financial implications: endogeneity issues and critical mass of females on corporate boards.

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Award date:
2019

Gender Diversity and Financial Implications:

Endogeneity Issues and Critical Mass of Females on Corporate Boards

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Submitted in total fulfilment of the degree of

Doctor of Philosophy

July 2018

Bond Business School

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This research was supported by an Australian Government Research Training Program Scholarship

Abstract

This study investigates the relationship between board gender diversity and company financial performance in Australia's ASX200 public listed companies from 2008 to 2015. It finds the conflicting findings in previous board gender diversity and company financial performance studies are caused by the endogeneity concerns and prior inadequate attempts to address the causality relationship. This study employs a comprehensive range of econometric techniques to demonstrate the confounding impacts of endogeneity. It highlights the consequences of previously applied econometric techniques in examining the causal relationship of a gender-diverse board on company financial performance. A novel external instrumental variable that fulfils both relevancy and exogeneity tests is used with dynamic GMM estimation that is robust to all potential source of endogeneity. This study shows no evidence that female board representation has any negative effects on company financial performance, as measured by Tobin's Q. This indicates that the significant correlations between board gender diversity and company financial performance as suggested by the OLS and fixed effects estimations are spurious as they fail to fulfil the strictly exogeneity assumptions between the dynamic nature of board characteristics and company financial performance measures. The inadequate attempts to address the endogeneity problems may lead to a spurious and biased inference of the relationship between the variables. The findings of this study show that board gender diversity has no significant relationship with company financial performance. Partitioning the sample into progressive increment of female board representation also suggests there is no negative or adverse impact on company financial performance. The evidence suggests that increasing the number of female board members does not reduce company financial performance. In the absence of significant relationship between board gender diversity and company financial performance, this study does not provide strong support to the Australian authorities to impose mandatory gender quotas in the public listed companies.

Statement of Originality

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of Doctor of Philosophy.

This thesis represents my own original work towards this research degree and contains no material that has been submitted for a degree or diploma at this University or any other institution, except where due acknowledgement is made.

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Lee Lee Ong

Acknowledgement

Firstly, I would like to take this opportunity to express my sincere gratitude to my principal supervisor, Associate Professor Simone Kelly for her continuous support to complete this study. She trusts me in my entire endeavour and has patiently guided me through the whole journey. Her immense knowledge in research, insightful comments and constructive criticisms, sincere encouragement and motivation are the most valuable resources in my entire research process. I am glad to have my secondary supervisor and mentor, Professor Keitha Dunstan, who is always there to aspire me, to stimulate and widen my research scope. Her knowledge in the relevant area and her passion for empowering females in every aspect of life has motivated me to continue this journey. Completing a Ph.D. degree is an uphill struggle with many obstacles in the process. This journey could not be realised without the support from both my supervisors.

I would also like to thank Professor Ray McNamara, who encouraged me to pursue my Ph.D. study four years ago. I would not have started this endeavour without his encouragement, assurance and trust.

This research is funded by the Australian Government Research Training Program Scholarship and supported by Bond Business School. I sincerely thank all the people and institutions that provide invaluable support in completing this study.

Lastly, I must express my profound gratefulness to my family. This accomplishment would not have been possible without my supporting family. To my two beautiful children, Christina and Christopher, completing this study is to display to both of them that learning is a life-long journey and we can accomplish anything if we strive for it. To my husband, my mother-in-law and sister-in-law for always give me unfailing support. To my late father-in-law and both my deceased parents, I owe this to all of you, and you will always be remembered along the journey, I sincerely thank you.

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List Of Abbreviations

Abbreviation	Detail Description
2SLS	Two-stage Least Square
AHRC	Australian Human Rights Commission
AICD	Australian Institute of Company Directors
ASIC	Australian Security Investment and Commission
ASX	Australian Stock Exchange
CEO	Chief Executive Officer
EBIT	Earnings Before Interests and Taxes
GFC	Global Financial Crisis
GICS	Global Industry Classification Standard
GMM	Genralised Method of Moments
IV	Instrumental Variable
NGOs	Non-Government Organisations
OLS	Ordinary Least Square
ROA	Return on Assets
ROE	Return on Equity
ROIC	Return On Invested Capital
ROS	Return on Sales
SIRCA	Securities Industry Research Centre of Asia-Pacific
SMEs	Small and Medium Enterprises
VROE	Volatility on Return on Equity
WGEA	Workplace Gender Equality Agency
WOB	Women on Boards

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Chapter 1: Introduction

1.0 Introduction

The fundamental concern in boardroom gender diversity and company financial performance studies is the existence of endogeneity issue in determining the causal relationship. Despite extensive literature in examining the relationship between gender-diverse boards and company performance, the endogenous nature of board gender diversity and company financial performance has limited our understanding on how, why and when gender-diverse boards affects company performance. For example, companies choose board structure that suits the nature of the business and industry, and at the same time companies that perform better also attract directors with certain characteristic. In relation to board gender diversity, is it the company's choice to appoint female directors to suit the business operation that enhances company financial performance or female directors choose to join the boards of the more successful companies? In this instance, it is difficult to establish a causality link between the board structure and the company performance. Gippel, Smith and Zhu (2015) suggest the most effective way to study the causal relationship in accounting and finance studies is by way of natural experiment. However this approach is challenging, as the opportunity for natural experiments to occur is rare in corporate governance study. The relationship between board structure and company financial performance can be explained by an empirical study that is not confounded by the endogeneity issue.

The endogenous nature of the corporate governance measures and company financial performance limits our understanding of the relationship between the variables. The three main endogeneity concerns in governance and performance literature are unobserved company-level heterogeneity, simultaneous causality bias and dynamic endogeneity between the variables in the model specification (Wintoki, Linck and Netter, 2012). This study applies various econometric techniques to demonstrate how the endogeneity problem leads to spurious and bias inference of the relationship between board gender diversity and company

performance. Following the suggestion by Pindado and La Torre (2004) that the most effective solution to control an endogeneity problem is by applying an external instrumental variable. The aim of this study is to introduce a valid and relevant external instrumental variable to remove the confounding effect between board gender diversity and company performance. This study believes that there is a positive association of the pool of female talent in a same area based on locality theory (Bouwman, 2012). Therefore, the representation of local female councillors is believed to have a positive influence on the experienced and skilled females to excel to the corporate boards. The selected external instrumental variable, the proportion of local female councillors, is economically relevant as shown in the relevancy F-test, indicating that the local female councillors is positively correlated to the proportion of females on boards. Furthermore, Hansen J-test confirms the validity of the selected external instrumental variable that is exogenous and uncorrelated to company performance. With the identification of the optimal external instrumental variable that is valid for GMM specification, this study applies the most appropriate dynamic Generalised Method of Moments (GMM) estimation to examine the relationship between board gender diversity and company financial performance. The dynamic GMM model is robust to all forms of endogeneity concerns and is well specified based on Hansen test of over-identifying restrictions and Arellano-Bond test of auto-correlation.

The findings of this study identified that the major sources of endogeneity in the relationship of board gender diversity and company financial performance arise from simultaneous causality, unobserved heterogeneity and the dynamic relationship of past performance on board structure. Board gender diversity has neither positive nor negative implications on company financial performance. The significant negative correlations as suggested in OLS estimations are spurious inference due to endogeneity issues. The findings also suggest that board gender diversity will not cause any decrease in company's capacity to create value as measured by Tobin's Q. The examination of female board representation based on Kanter's critical mass (1977b) classification reveals that the relationship between board gender diversity and company financial performance could be non-linear. In the absence of significant relationships between board gender diversity and

company financial performance, this study does not provide strong support to the Australian authorities to impose mandatory gender quotas in the public listed companies. This is aligned with Ahern and Dittmar's (2012) study on Norway's gender quota legislation that lead to an adverse effect on company value. Economic theory of equilibrium also argues that if board structure of a company is at its optimal level, implementing gender quota may lead to a sub-optimal board that is detrimental to the company financial performance (Gippel et al. 2015).

1.1 Overview Of Corporate Governance And Board Gender Diversity In General

The role of corporate governance has lead to contentious and intensive debates especially after the collapse of high profile corporations at the beginning of the twenty-first century and post-Global Financial Crisis (GFC) in 2008. Corporate failures such as Enron and WorldCom in the U.S., HIH Insurance and OneTel in Australia in 2001 resulted in the review of the corporate governance system around the world and the call for better and more effective corporate governance. The fundamental function of corporate governance is to ensure that management acts in the best interest of the stakeholders through a variety of mechanisms. The duty of the board of directors is to achieve efficient and better governance with effective strategic decision-making and monitoring function. This requires strong cooperation and effective teamwork among the board members. In principle, effective corporate governance will ensure the efficient use of company's internal and external resources to improve shareholders' returns. In this instance, well-structured corporate governance should have positive impacts on company financial performance. The governance structure that affects company financial success can be classified as the internal and external mechanism. The board composition, executive compensation and ownership of managers fall under the internal mechanism of corporate governance; while institutional ownership, leverage level, market outlook and strategic direction of the company are considered as the external mechanism of the corporate governance. Hence, corporate governance structure and company financial performance are jointly determined.

Board composition concerning gender diversity is currently under intense debates globally, where governments around the world have taken initiatives to improve female board representation. Corporations are also facing political and societal pressure to address gender equality issues. The under-representation of females on corporate boards has gained considerable international attention amongst policymakers and corporations. Both authorities and institutions have taken necessary measures to respond to the increasing demand for female board representation. Authorities and institutional diversity requirements can be classified into two categories: a hard law through a regulatory mandate by legislation or a soft law through highly recommended best practices (Ben-Amar, Francoeur, Hafsi, & Labelle, 2013).

The first country that implemented mandatory rules and regulations to legislate board gender quotas is Norway, who leads the international policy to enact the mandatory law and to impose gender quotas in 2003. Under the gender diversity requirement, all Norwegian public listed companies are required to achieve a minimum of forty percent of female directors quota by 2008. Spain followed Norway's gender reform and enacted the gender diversity law in 2007 and mandated all public listed companies to increase female board representation to forty percent by 2015. Many countries in the European continent have also followed this corporate board gender reform and imposed the corporate gender requirements[1].

On the other hand, some countries choose to implement a soft approach and provide guidance in recommending a non-binding gender target to improve female participation on the corporate boards. The countries that provide guidance on boardroom gender recommendation without imposing mandatory gender quota, to name a few, are Australia, New Zealand, Switzerland and the United Kingdom. In the U.K., the Higgs Report (2003) recommended that board diversity enhances board effectiveness in decision making and encourage company to improve board gender diversity from professional group where females are well represented.

[1] Refer Appendix 1 on boardroom gender quotas laws and corporate governance recommendations by country.

Subsequently, in 2011, the U.K. government-backed Davies Review has set a non-binding gender target at twenty-five percent of female board representation of FTSE 100 companies by 2015. In Australia, the Australian Stock Exchange Corporate Governance Council has also recommended boardroom gender diversity policy based on the "comply-or-explain" provision. The European Commission also proposed a minimum of forty percent of female non-executive directors for companies listed on the European boards by 2020. The initiative for the legislative requirements and corporate governance best practice recommendations on gender policy are based on the perception that board gender diversity affects the corporate governance structure and board dynamics in a positive manner. The increasing representation of females on boards has disrupted the norms of the traditional male-dominated boards. Females are now being sought for board positions to comply with the legislation and corporate governance guidelines (Sheridan, Ross-Smith, & Lord, 2014) .

Despite the government and institution's intervention on board gender policy, females are still under-represented on the corporate boards. According to the latest update statistics by ISS QualityScore (Azhar, Martens, Papolis, & Sancho, 2017) , a study based on thirty countries over five continents, female board representation remains below twenty percent in 2016 globally. Another global board diversity review based on the public listed companies of forty-four countries from 2012 to 2016 also indicates that the progress in board gender diversity remains slow. The review shows that female directors only represent nineteen percent of the directorships (EgonZehnder 2017), an improvement of only five percent over the four years period. Countries in Western Europe show the most significant improvement in board gender diversity over the years from 2012 to 2016. The average female board representation has increased from 18.5% in 2012 to 26.2% in 2016 globally. Amongst the Western European countries, those implemented mandatory gender quotas are regarded as the diversity champions. Norway, being the top on the list, has forty percent of female board representation on the public listed companies. This is followed by France, Sweden, Finland, and Italy with female board representation ranged between thirty and thirty-seven percent. In the U.S., despite being the pioneer in promoting boardroom gender

diversity, female board representation remains stagnant. In this instance, female directors in the U.S. hold only twenty percent of the board seats amongst the Fortune 500 companies in 2016 (Deloitte, 2017).

The global statistics on boardroom gender diversity (EgonZehnder, 2017) shed some light on the progress of female board representation from the introduction of mandatory gender quotas and voluntary recommendation by the government. However, there are cases where regulations may not be effective in advancing female directors on the corporate boards. For example, in Germany and Spain, females represent only twenty-eight and twenty-one percent respectively as at 2016, still fall short of the mandatory quotas of thirty percent. The under-representation of females on boards is due to lack of enforcement from the authorities despite there is a mandatory requirement in place. In addition, females' progression onto corporate boards also encounters social, political and cultural challenges. This is particularly true in the boardroom of companies in the Asia region. Female board representation in Asia is well below the global progress where females represent only eight percent of the board directorships. Among the countries in the study, the proportion of female directors in China, Japan, and South Korea are well below one percent. This is due to the deep-rooted traditional cultural and societal attitude towards females remain the primary barrier for their advancement onto the top management and corporate boards.

In view of the global governance initiatives in promoting boardroom gender diversity, the emerging empirical studies in the area of effective board composition concerning gender diversification have also gained researchers' attention. These empirical studies attempt to examine what are the implications of having more gender-diverse boards and whether the gender diversity policy is in line with the government's intention in promoting female board representation. Many studies hypothesise the benefits associated with board gender diversity to organisational level, where female directors contribute in delivering new perspectives (Kiel & Nicholson, 2003) , effective communication (Almazan & Suarez, 2003) , more independence board structure that enhance monitoring and effective board strategic control (Adams & Ferreira, 2009; Gul, Hutchinson, & Lai, 2013) ,

enhances company financial performance and image by providing more legitimacy to diverse stakeholders (Hillman & Dalziel, 2003) .

Another stream of literature examines the effective number of female board representation that influences company performance. These studies apply Kanter's critical mass theory and posit that female representation on boards can only produce a positive and sustainable effect when female directors reach a critical mass of boardroom representation (Joecks, Pull, & Vetter, 2013; Kanter, 1977b; Strydom, Au Yong, & Rankin, 2017) . In general, previous studies suggest a critical mass of thirty percent or a minimum of three female directors on boards is the tipping point for female directors to make practical contributions to the boardroom discussions and board dynamics that positively impact the company performance. However, the latest statistics of the global gender diversity analysis (EgonZehnder, 2017) indicates that the average female directors on boards in 2016 is about two directors[2], suggesting that with the current increment rate of female board representation, boards will only achieve the critical mass of three female directors by 2021. This is an optimistic prediction as most of the countries that reached the critical mass of female board representation are in the developed nations with gender policy in place. Two-third of the countries in the study have not achieved the critical mass of female board representation and there is minimal gender priority and agenda. Furthermore, majority of the female population are residing in the countries with social, political and cultural challenges that may slow down the progress.

1.2 Corporate Governance And Board Gender Diversity In The Australian Context

Given the snapshot of the global corporate boardroom gender diversity, this study explicitly focuses on the boardroom gender diversity in the Australian context and investigates the implications of board gender diversity on company financial performance. We begin this section by presenting a brief introduction on the

[2] Refer Appendix 2 on the 2016 Global Board Gender Diversity Analysis – Average female directors on board by diversity champions. Retrieved from https://www.egonzehnder.com/gbda

Australian corporate governance system. This is followed by a general discussion of gender diversity in Australia that leads to the questions raised in view of the current boardroom gender diversity phenomena. The final part of this section demonstrates how these questions can be answered and the contributions of this study.

1.2.1 Australia Corporate Governance Structure in General

Consistent with the framework of corporate governance, corporate boards in Australia are responsible and accountable for governing and overseeing the overall strategic direction and top management function of companies. Public listed companies in Australia are highly regulated by the Corporation Act (2001) and the Australian Stock Exchange (ASX) listing rules. Principle 5 in the ASX listing rules required that all public listed companies to establish written policies and procedures that are designed to ensure compliance with the ASX listing requirements. The senior management team together with the board of directors are responsible and accountable for the compliance requirements. Despite being one of the world's leading countries in establishing the corporate governance structure and listing requirements, the Australian corporate environment cannot avoid from the corporate failures in the early twenty-first century. Prominent listed companies such as HIH Insurance, OneTel, Harris Scarfe and Ansett Airlines collapse in 2001 due to weak corporate governance, unsustainable business strategy, aggressive financial reporting and poor auditing (Monem, 2011). These corporate failures have reinforced the Australian corporate governance landscape (Mirshekary, Yaftian, & Cross, 2005) and emphasise the importance of good corporate governance practices and structure. In the case HIH Insurance, a Royal Commission was established to investigate the reasons and the circumstances of the failure. The Royal Commission report stated that the primary reason for the failure of HIH Insurance was due to poor management and lack of integrity in the internal processes and systems. There is due to lack of attention and accountability from the senior management and board of directors (Treasury, 2003). As a result of the Royal Commission findings on HIH's collapse, the Australian Securities Exchange Corporate Governance Council (herein refer to as The Council) has established the Principles of Good Governance and Best Practice Recommendations in 2003 to further enhance the corporate governance

standards of public listed companies. The Council's recommendations cover a wide range of corporate governance charters, including board roles, responsibilities and composition; code of conduct of board of directors; financial reporting and continuous disclosure; risk management framework and directors remuneration framework.

To summarise the corporate governance landscape in Australia, the Corporation Act (2001) and the ASX listing rules provide the mandatory requirements for the companies while the Australian Security Investment and Commission's (ASIC) policy and The Council's recommendations provide guidance, obligations and disclosure requirements for public listed companies. Under ASX listing rules 4.10.3, all public listed companies are required to benchmark their corporate governance practices against The Council's best practice recommendations. Although the ASIC's policy and The Council's recommendations are non-mandatory in basis, they supplement the ASX listing rules in governing the affairs of public listed companies.

In addition to the mandatory legislation and the guidelines and recommendations, the charter of a company's corporate governance framework also encompasses the rules, regulations and policies of a company. While the public listed companies have the flexibility to implement their own set of corporate governance policies, The Council adopts "if not, why not" approach when the companies do not conform to the recommendations. This approach requires that all public listed companies to inform the stakeholders as to what extent the company followed The Council's recommendations and to identify and provide reasons for not following. In this instance, the institutions and both internal and external stakeholders play an important role in shaping the governance attributes of an organization that influences a company's corporate governance structure. An effective governance framework encompasses corporate governance charters, determines the codes of conducts and policies of the boards, helps to enhance a company's strategic performance and to ensure conformance with company's internal constitutions as well as external regulations and laws.

1.2.2 Gender Diversity In Australia

Females in Australia have been actively involved into domains that traditionally were dominated by male counterparts. Lifting female participation in the Australian workforce has been a significant national productivity plan. The collaborative approach between the Australian's regulatory bodies and the non-government organisations (NGOs) plays an important role in encouraging and promoting the advancement of females' participation in the workforce as well as senior executive position and leadership roles in the corporate environment. In 2012, the Workplace Gender Equality Act (2012) was introduced to replace the Equal Opportunity for Women in the Workplace Act (1999). This newly enacted Act focuses on addressing the gender inequalities in the Australian workforce by promoting and improving gender equalities for both genders. Under this Act, all non-public sector employers with 100 or more employees must submit an annual report to the Workplace Gender Equality Agency (WGEA) benchmarked against the six gender equality indicators[3].

The Australian government regulatory bodies and NGOs' promote gender equality in the workforce and advancing capable female employees onto the senior executive and top management level in the corporation. Workplace Gender Equality Agency (WGEA) also works toward dismantling the cultural and structural barriers that limit women's capability to participate in workforce and progress in leadership roles to achieve gender equality. There is a considerable volume of information and statistics available that shows the increment of females' participation in the workplace has improved substantially since the 1980s. 46.9% of all employees comprise of females workforce, and women made up to 36.8% of full-time employees and 68.6% of part-time employees (WGEA, 2018). Females also compare favourably to men regarding education attainment in Australia. WGEA's 2017 statistics show that 39.9% of females aged between 25-29 have achieved a minimum of bachelor degree compared with 30.9% of males in the same age group. In the population aged between 15-64, 5.9% of females have attained a postgraduate degree, slightly higher than their counterparts at 5.8%. This indicates that females have significant human capital and education

[3] Refer Appendix 3: Six gender equality indicators

background to contribute towards the workforce as well as have the potential and capability to be promoted onto the leadership role and be qualified to be directors on the corporate boards. The report on females on leadership also indicates that females have consistently advanced in all categories of managerial roles since 2013 and females representing 38.4% of the overall managerial position in 2016[4].

The advancement of females in the workforce at the senior executive roles and the leadership level has gathered considerable momentum and increased the appetite for participation increment on corporate boards. One of the NGOs that play an important role in promoting and advancing female participation on corporate boards is the Australian Institute of Company Directors (AICD), a non-profit corporate governance association. The AICD offers professional advice to its members and supports its members by providing career development and mentoring programs to encourage more females to be board ready and to advance to corporate board membership. The ASX and the AICD play an active role in advancing females on corporate boards by providing mentoring and scholarship programs to encourage females to undertake formal training to be qualified as directors on the corporate boards. Commonwealth and state governments have also set up a registry for females who are interested in joining government boards. Another membership-based NGO, Women on Boards (WOB), offers a supportive service to their member who is seeking for corporate boards position to register their details and organise seminars and workshops to enhance the board-based knowledge. WOB also publishes the information about companies in search of female directors and emphasises gender diversity as an objective.

Similar to the boardroom gender diversity scenario around the world, despite the efforts of the Australian regulatory bodies and the NGOs in promoting females' advancement onto the corporate boards, female board representation remains low. The issue of low representation of females on corporate boards in Australia has received special attention of the ASIC and The Council. In July 2010, The

[4] Refer Appendix 4: Women in Leadership statistics. Extract from WGEA's report on Australia's gender equality scorecard.

Council introduced the diversity recommendations in response to the Australian Government's Corporations and Markets Advisory Committee's report on issues concerning "Diversity on Board of Directors". The first version of diversity recommendations[5] was introduced in The Council's amended second edition of the "Corporate Governance Principles and Recommendations 2010". In general, the diversity recommendations can be classified into three sections: Recommendations 3.2 and 3.5 concerning the diversity policy and reporting; Recommendation 3.3 concerning the measurable objectives; and Recommendation 3.4 concerning gender diversity metrics. These recommendations suggest that all public listed companies to establish a measurable gender diversity policy to improve board gender diversity, and adopted the self-regulated disclosure approach on board's diversity disclosure requirement to explain if it has deviated from the set objectives. Although it is not a statutory requirement and no mandatory disclosures are required, all Australian public listed companies are recommended to disclose their gender diversity policy in their annual report commencing 2011. Companies that elect not to adopt these gender diversity recommendations are required to provide an explanation based on the "if not, why not" principle. In 2014, under the third edition of The Council's "Corporate Governance Principles and Recommendations", the diversity recommendation[6] has been relocated from Principle 3; under the subheading "ethical and responsible decision-making"; to Principle 1, under subheading "lay solid foundations for management and oversight". This relocation indicates that The Council recognises that diversity should be a critical component for companies to establish effective management rather than just as an ethical recommendation.

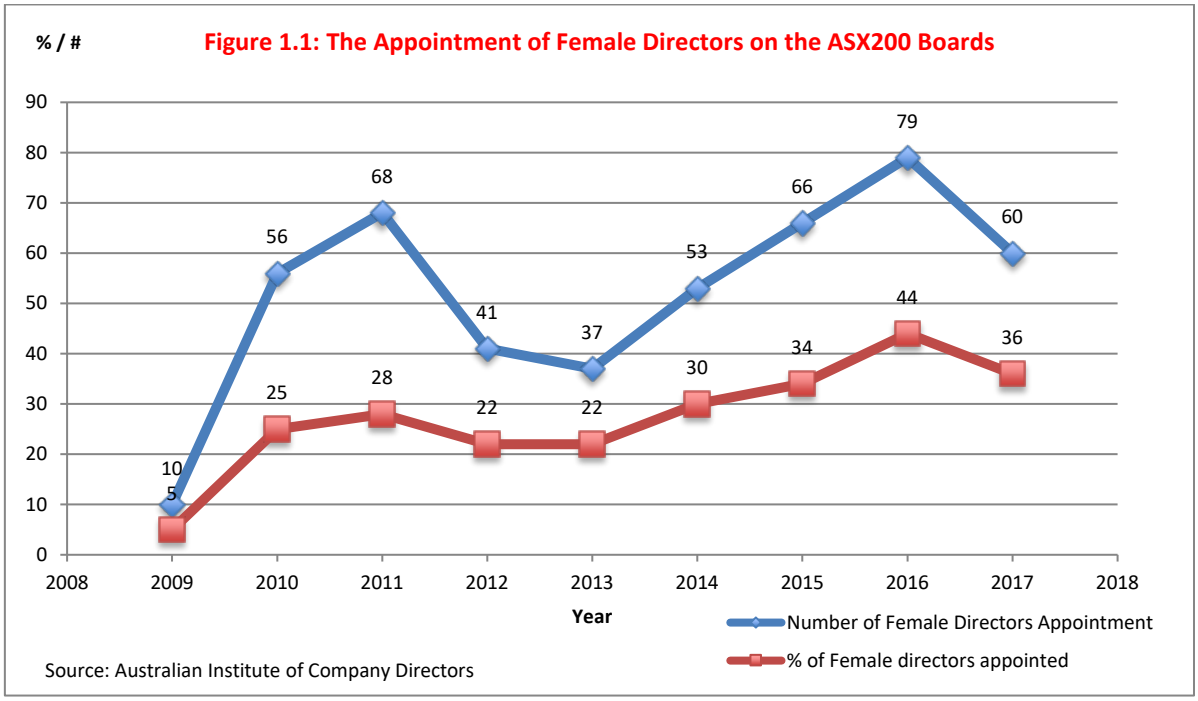
The initiative of these government authority bodies and NGOs provide supportive data and enhance the understanding of the diversity issue in the workforce. The datasets of the WGEA and the AICD provide the most comprehensive information

[5] Refer Appendix 5: Principle 3 of The Council's 2010 Gender diversity recommendations in the "Corporate Governance Principles and Recommendations"
[6] Refer Appendix 6: Principle 1 of The Council's 2014 Diversity Recommendations. Retrieved from http://www.asx.com.au/regulation/corporate-governance-council.htm

of gender equality in the Australian workplace and the public listed companies in the ASX. These datasets provide a standardised performance assessment and comparison across industries in Australia. Business and policymakers are able to benchmark both occupational gender gaps that exist amongst industries as well as females in the leadership role and management levels. This allows a high-level understanding of gender equality in the workplace and encourages the management to put in place long-term measures to address inequalities and low representation of females at the higher level of the organization and the board level. The AICD's report on the appointees' qualifications of directors between 2014 and 2017 in the ASX200 boards[7] reveals that female directors possess higher qualification than male directors. The report shows that all female directors hold formal qualification compared to 94.8% of male directors. 37% of female directors possess postgraduate qualification compared to 31% of male directors and 26.1% of female directors are MBA holders compared to 21.8% of male directors.

The efforts of the government bodies together with the support from the NGOs have encouraged females' advancement onto the corporate boards and created an immediate reaction with the greater appointment of female directors on the ASX200 boards. Figure 1.1 shows that the appointment of female directors on the ASX200 boards from 2009 to 2017. The number of female directors appointed onto the ASX200 boards has increased from 10 in 2009 to 56 and 68 in 2010 and 2011 respectively. This is an increment of 460% in 2010 from 2009 base level, and another further increment of 120% in 2011. The appointment of female directors has dropped to the low of 37 appointees in 2013 but again has gradually increased and reached the highest number of 79 appointees in 2016. In relative terms, the appointment of female directors represents 25% and 28% of the total new appointees in 2010 and 2011 respectively. However, the rapid increments of the appointment of female directors have decreased to 22% in 2012 and 2013. The number of new appointment of female directorship has achieved another spike in 2016, representing a total of 44% of new appointments.

[7] Statistics extract from AICD's web-site at http://aicd.companydirectors.com.au/advocacy/board-diversity/statistics

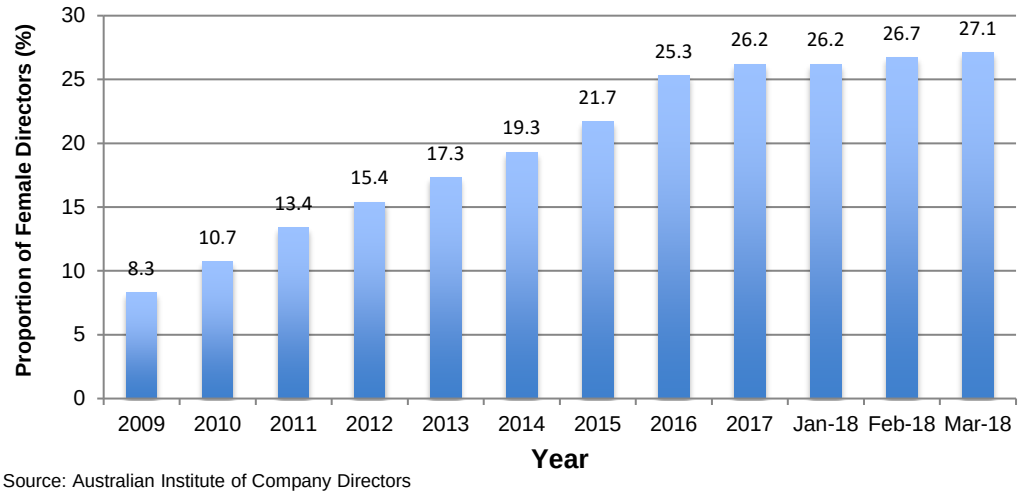


Despite the striking increment in new appointments of female directorship in the ASX200 since The Council's best practice gender diversity recommendations, the percentage of female directors on ASX200 boards remains low and well below the best practice target of forty percent[8]. Figure 1.2 presents the proportion of female directors on the ASX200 boards from 2009 to 2017. The statistics show that although the number of female directors in the ASX200 has increased from 65 before the recommendation to 84 between July and December 2010, it represented only 10.7% of the total board directorship on the ASX200 in 2010. The increment of the proportion of female board representation is rather slow and only achieved to its peak of 26.7% as at March 2017[9]. The latest AICD's report shows that there are 14 companies in the ASX200 have no females on boards and only 70 companies in the ASX200 have reached 30% target of female board representation (AICD, 2017). This indicates that the remarkable increment in newly appointment of female directors of the ASX200 has only a minor impact on actual female representation across the entire ASX200. It also signifies that the

[8] This benchmark is in accordance to AHRC's 2010 blueprint on gender diversity and equality recommendations.
[9] This statistics is extracted from the live data in the AICD's web site retrieved from: http://aicd.companydirectors.com.au/advocacy/board-diversity/statistics

appointment of female directors in corporate boards do not reflect the gender workforce and education attainment's statistics. Females are under-represented on the corporate boards and remain largely excluded from board positions. Male counterparts continue to dominate the ASX200 boards and overshadow the increment of new female directorship.

Figure 1.2: Female Board Representation on the ASX200 Boards



Source: Australian Institute of Company Directors

The statistics demonstrate that Australia has a long way to go in achieving the world benchmark of forty percent female representation on corporate boards. McKinsey (2007) in their report "Women Matter" stated that corporate culture plays an important role in advocating gender diversity of a company. They suggested that top management's commitment to gender diversity should be on the top list of strategic agenda. They termed this effort as "the ecosystem of measures" where the top management commits to closely monitor the implementation of gender policy progress and develop programs that encourage females to excel in the leadership position. Not unless the company and the board are made accountable to implement the diversity policy, it is very difficult to change the general perception within the company and gain acceptance of female leadership in the senior executive positions and representation on boards.

The voluntary and best practice recommendations employed by The Council can be a slow process for the public listed companies in Australia to achieve gender

diversity targets, either at the suggested critical mass of thirty percent or the most common gender quota benchmark in the Scandinavian nations of forty percent. In view of the international trend in implementing quota legislation and progress towards setting best practice targets, is a mandatory gender quota the more effective way to improve female board representation to achieve gender diversity targets? Subsequent to The Council's gender diversity recommendation in 2010, the Australian Human Rights Commission (AHRC) proposed a gender equality blueprint for both the public and private sectors. Recommendation 7 of the blueprint suggests that the Australian government should legislate all public listed companies to achieve the minimum of forty percent of female board representation within the 5-year period[10]. They further recommended that if this mandatory gender diversity target is not achieved within the specified time frame, penalties should be imposed. The AHRC's recommendations contribute towards The Council's gender diversity voluntary approach by quantifying the measurable objectives to set a forty percent quota as the board gender target that is consistent with international practices. The AHRC suggests that setting quantifiable targets is an effective way to benchmark Australian public listed companies' gender diversity policy and progress in comparison to other nations.

On the other hand, the AICD opposed setting a gender quota on public listed companies boards. However, in 2013, the newly appointed chairman of the AICD, Elizabeth Proust, has indicated that if female representation on the ASX200's boards does not achieve the thirty percent benchmark, the realistic option to improve female representation on boards is by way of imposing mandatory legislation. She also indicates that thirty percent of female board representation is the desire target for companies listed on the ASX. The AICD is committed to improve boards gender diversity and has called for all the ASX200 boards to achieve thirty percent of female representation on boards by the end of 2018. In 2014, the Australian Council of Superannuation Investors (ACSI) also announced their investment policy in the ASX200 companies and suggested the gender target for female board representation at thirty percent to be achieved by 2017. The

[10] Refer Appendix 7: Extract of the Australian Human Rights Commission's recommendations on gender diversity and equality.

ACSI recognises that properly structured boards should comprise of directors with diverse backgrounds to enhance boards' effectiveness in decision-making. They also announced to vote against the re-election of directors for companies with poor board gender diversity.

1.3 Empirical Studies Concerning Boardroom Gender Diversity In Brief

The optimistic remarks and perceptions of the government bodies and the NGOs in claiming that increased board gender diversity is associated with improve workforce participation at all levels and positively impacts the economy and company financial performance have not been supported conclusively in the academic studies. Previous empirical studies suggest mixed evidence between female's participation on corporate boards and company financial performance, including assertions of positive correlations between board gender diversity and performance, negative correlations or no significant impact of gender-diverse boards on performance. The main reason that leads to the inconclusive findings of previous empirical studies is due to the methodological concern on endogeneity issue and theoretical assumption of linear correlation between board gender diversity and company financial performance.

In Australia, empirical study that examines boardroom gender diversity and performance is less developed compared to the U.S and other developed countries in the European region. Appendix 8(a) tabulates the previous empirical studies that use the Australian data to examine the relationship between board gender diversity and company financial performance while Appendix 8(b) presents the Australian study in another area of corporate governance. The Australian studies prior to the twenty-first century are primarily descriptive, focusing mainly on describing the board characteristics, board size and board composition (Kiel & Nicholson, 2003) . The findings of the Australian sample also suggest a similar result to the existing empirical studies of other countries that yield no general consensus on the relationship between board gender diversity and company financial performance. This study posits that two main issues needed to further clarify in examining the relationship between board gender diversity and company

performance, the methodological concern and the theoretical concern. We will further elaborate these concerns in the following section.

1. 4 Motivations and Objectives of the Study

This study is motivated by the governance reform proposal implemented by many countries based on the contention that gender diversity on corporate boards improves company financial performance. In Australia, The Council and the proponent for board gender diversity NGOs are of the view that companies with gender-diverse boards could improve their overall performance. These institutional influences have put pressure on companies to comply with the requirements to increase female representation on their boards. Furthermore, there is no general consensus based on the economic argument on the gender-diverse boards from previous empirical studies. It is important for both the government policymakers and the governance of the companies to understand the actual implications of having gender-diverse boards. If the boardroom structure and composition are at its internal equilibrium, forcing companies to change the boardroom structure to comply with the required legislation can be detrimental to the company financial performance (Ahern & Dittmar, 2012; Nygaard, 2011) .

Methodologically, the inconclusive and controversial evidence lies in the fact that endogeneity problem exists between board gender diversity and company financial performance. This endogeneity issue is caused by the possible simultaneous relationship, company-level heterogeneity and dynamic endogeneity between the variables in the model specification (Wintoki, Linck, & Netter, 2012). Moreover, data used from different countries with different jurisdictions and corporate governance practices also lead to diverse findings. The large body of previous literature also apply the whole spectrum of diverse model specifications with the application of various econometric techniques over a different time frame that led to inconsistent results.

Theoretically, board gender diversity enhances boardroom efficiency and dynamics that positively affects overall company performance. However, different

theories support the relevancy of gender-diverse boards and its implications on company financial performance in a different way that may result in contradictory arguments. Furthermore, the model specification of previous studies is based on the expectation of a positive linear relationship between female participation and company performance. Logically the relationship between board gender diversity and company financial performance should not be linear. We posit that token female director will not positively affect company financial performance until a critical mass is reached, and at some point increased female participation beyond the optimal level of board composition will become value decreasing as male participation decreases and the benefits of diversity are diminished.

Given both the methodological and theoretical concerns in board gender diversity and performance studies, the main objective of this study is to improve on both concerns by applying the most appropriate and advance econometric techniques and introduce a valid and supportive external instrumental variable to address the endogeneity issue. We hope to answer the following questions raised by the government initiatives in implementing gender policy and the inconclusive empirical evidences in company financial performance and board gender diversity studies as follows:

1. What is the main endogeneity issue resulting in inconclusive or spurious findings in board gender diversity and company financial performance studies?
2. If we can address the endogeneity concern using the advancement of econometric techniques, what is the implication of gender-diverse boards on company financial performance?
3. With the application of the appropriate econometric methods, is the relationship between board gender diversity and company financial performance linear?
4. What is the tipping point for female directors to make a difference in company financial performance?

1.5 Importance And Contributions Of This Study

This study empirically tests the implications of board gender diversity on company financial performance in the Australian context and contributes to the existing board gender diversity studies to understand whether female board representation affects company financial performance. Given the fact that the essential roles of corporate governance; being the most influential body in setting company's strategic direction and determining the allocation and utilisation of resources to generate the desired outcomes of the company; it is important to understand the most fundamental question whether board gender diversity affects board's strategic decision that flows on to the company financial performance. Furthermore, with the initiatives of the regulatory authorities around the world in promoting board gender diversity policy, there is more of a reason for the researchers to investigate the real economic impacts of gender-diverse boards.

This study is noteworthy particularly in the Australian context in view of the gender diversity initiatives by the government regulatory bodies (the ASIC and ASX) on public listed companies' gender policy and other NGOs and institutional push for mandatory gender quotas if females continue to be under-represented on the corporate boards. It is timely to examine whether there is a causal relationship between board gender diversity and company financial performance to support the policy debates. Although there have been increasing studies in the literature examining the relationship between board gender diversity and company financial performance, studies focus predominantly in the Australian context between board gender diversity and company financial performance are limited, and the results are inconclusive [11]. These studies suffer from both the methodological and theoretical flaws that diminish the credibility of their evidence due to the most damaging endogeneity issue in diversity-performance studies. Consequently, we are unable to derive meaningful inferences from these studies on the causality relationship between board gender diversity and company financial performance.

[11] Refer Appendix 8(a) for the studies with the Australian sample in relation to board gender diversity and performance and Appendix 8(b) on the Australian study in another area of corporate governance

The main methodological weakness of the extant research in the Australian context lies in the inadequacy of attempts to address the damaging endogeneity issue present in diversity-performance studies. Given the inconclusive results in the academic community due to the most damaging methodological flaws in previous studies, this study contributes to the existing literature by addressing this endogeneity concern. We apply the more advanced and appropriate econometric methods to examine the relationship using the dynamic Generalised Method of Moments (GMM) estimations (Schultz, Tan, & Walsh, 2010; Wintoki, Linck, & Netter, 2012) . Furthermore, this study is important not only by applying a well-structured dynamic modelling approach to improve on the inconclusive findings but also introducing a carefully selected external instrumental variable to control for the loop of causality between board gender diversity and company financial performance. The quality of the choice of external instrumental variables utilised in previous studies has been cirticised for their weakness and lack of theoretical reasoning that cause logical plausibility. A valid external instrument variable based on economic theory and fulfil both the relevancy and exogeneity tests produces unbiased estimates in the structural model may provide evidence of a relationship between board gender diversity and company financial performance. Therefore, this study applies the theory of “economic ramification of distance” (Bouwman, 2012) and the influence of political science in corporate governance (Terjesen, Aguilera, & Lorenz, 2015) in the selection of the external instrumental variable of this study. This study identifies the representation of local female councillors as the important influence on local female board representation. The representation of local female councillors is believed to have a positive influence on the experienced and skilled females to excel as directors on corporate boards. This is demonstrated in our endogeneity test and the relevancy F-test of the selected instrumental variable. The exogeneity Hansen-J-test in the dynamic model also presents that the selected external instrumental variable is exogenous and uncorrelated to the errors in the company financial performance measure, indicating that the selected external instrumental variable is a strong inference to address the endogenous female directors regressor in the model.

The theoretical problem lies in the fact that, while researchers argue that gender diversity improves the quality of decision making of boards, enhance board effectiveness and hence company financial performance, their model is most often based on the expectation of a positive linear relationship between gender-diverse boards and company financial performance. Furthermore, the relationship between board gender diversity and company financial performance is not predictable by any single extant theory (Carter, Simkins, & Simpson, 2003) and there is always the opposite argument on the relationship between board gender diversity and company financial performance within the theoretical argument itself. This study contributes to the existing literature, especially in the Australian context, by referring to the multiple theories to understand both the positive and negative impacts of gender-diverse boards. We further apply Kanter's critical mass theory (1977b) to examine the possibility of a non-linear relationship between the different grouping of female directors on boards and company financial performance. We argue that the effects of gender-diverse boards should not be linear as the impact of a different grouping of female directors on boards affect board dynamics in various ways. In this instance, the relative number of female directors on boards influences board dynamics and outputs differently. Several studies refer to Kanter's critical mass theory in analysing group discussion processes and the implications of boardroom gender diversity. However, this critical mass theory has rarely been tested empirically in boardroom gender diversity and company financial performance studies in the Australian context.

In summary, considering the government regulatory bodies and NGOs approach in intervening corporate boardroom gender policy, this study is timely to examine if there is any causal relationship between gender-diverse boards and company financial performance in the Australian context. This study also contributes to the literature in boardroom gender diversity and company financial performance by addressing both methodological and theoretical concerns. Based on a stronger theoretical basis for the choice of a valid and relevant external instrumental variable, this study illustrates that the negatively spurious relationship between board gender diversity and company financial performance is due to the endogeneity issue. We also demonstrate that the relationship between boardroom

gender diversity and company financial performance varies depending on the estimation method of a study and different sources of endogeneity that cause a study to report a spurious negative correlation. This is the first empirical study in the Australian corporate boardroom context that applies the critical mass theory together with a well-structured dynamic modelling approach. This study also introduces a truly exogenous external instrumental variable to control for any potential source of endogeneity to examine the implications of different female directors grouping on company financial performance.

1.6 The Organisation Of The Thesis

This thesis is systematically structured to investigate the relationship between board gender diversity and company financial performance. In Chapter two, we present the theoretical constructs and literature reviews that are related to board gender diversity to provide a background understanding of how boardroom gender diversity may affect company financial performance and other board dynamics. This is followed by hypothesis development and construction of the conceptual framework of this study. Chapter three discusses the methodology of this study and presents the most contentious endogeneity issue between female board representation and company financial performance. This chapter also describes the data and the variables of this study. We then demonstrate the theoretical basis and biases of the commonly used estimations in board gender diversity and company financial performance study. Chapter four applies the necessary diagnostic tests and presents the empirical analysis using various statistical techniques that are commonly used in the literature. We conclude this chapter by comparing the results from the econometric techniques of this study and discussed accordingly. Chapter five concludes this thesis by demonstrating how this study contributes to the existing literature, follows by tabulating the limitations of this study and suggestion for future study.

Chapter 2: Theoretical Constructions, Literature Reviews, And Hypothesis Development

2.1 Introduction

There is an increasing number of studies investigating the implications of board composition on company performance. Heterogeneous board composition can be distinguished as either observable diversity or unobservable diversity (Erhardt, Werbel, & Shrader, 2003) . Observable diversity includes demographic characteristics such as gender, ethnic groups, nationality and age. Unobservable diversity relates to cognitive characteristics like knowledge, education, qualification, experiences, perspectives and other personal characteristics. This study empirically investigates the demographic issue of board gender diversity and its implications on company financial performance. The first two sections of this chapter provide both theoretical constructs and empirical evidence to evaluate the effect of board gender diversity on company financial performance. The final section of this chapter will present the conceptual framework of this study that links the theoretical constructs and empirical studies to the development of the hypotheses that examine the relationship between board gender diversity and company financial performance.

2.2 Theoretical Framework In Corporate Governance and Board Gender Diversity

Finkelstein, Hambrick and Cannella Jr (2009) indicate that there are two key functions of boards that relate to company performance. Firstly, the board of directors is the influential actors in the company that determine the strategic direction and decision-making inherent in the structural position. Secondly, boards of directors fulfil their monitoring role to the management team which includes monitoring proper use of company's assets and resources, representing shareholder to safeguard their investment and response to takeover threats. Prior literature on board gender diversity and performance studies also provides some

evidence that the increment of female board representation may improve the effectiveness of the boards' strategic direction and efficient monitoring function, and consequently have a positive impact on company performance. This study takes on this notion and examines the relationship between board gender diversity and its implication on company financial performance.

This sub-section presents the theoretical constructs that form the backgrounds and arguments for corporate governance in general and more specifically to gender diversity in the boardroom. Daily, Dalton and Cannella (2003) suggest that it is necessary to use multiple theories in corporate governance studies to enable the understanding of interrelated mechanisms and structure of the gender-boards and company performance. Carter e.t al. (2010) indicate that no single theory can predict the nature of the relationship between board gender diversity and performance and different theories support the relevancy of gender-diverse boards and its implications on company financial performance in different ways. Hence, this study covers a wide range of theories that relate to corporate board gender diversity and its implications on company overall outcomes, and more specifically on company financial performance. We present the most commonly used theories to evaluate the impacts of gender-diverse boards on company performance. These theories are agency theory (Jensen & Meckling, 1976; Fama, 1980), resource dependency theory (Salancik & Pfeffer, 1978), human capital theory (Becker, 1964), gender differences theory (Gray, 1992) and group effectiveness theory (Gladstein, 1984). We also include Kanter's critical mass theory (1977a) to examine the implications of different groupings of the proportion of female directors on company performance.

2.2.1 Agency Theory

Jensen and Meckling (1976) posit that the underlying principle of agency theory is the potential of conflict of interest between the management team and the shareholders, where the management team tends to be self-interested and is likely to maximise their benefits at the expense of the shareholders. Therefore, the fundamental principle of agency theory suggests that board's duty is to monitor and control the management team of a company with the intention to align any

inherent conflicts of interest between owners and management (Jensen & Meckling, 1976) . The primary goal of the board of directors is to ensure that the management team acts in the best interest of the shareholders to reduce agency costs. Research shows that companies with strong governance structure have minimal agency problems and consequently perform better (Core, Holthausen, & Larcker, 1999) . Hence, good corporate governance is an essential tool in the organisational context to mitigate agency problems that arises due to the separation of ownership and management control of companies.

Many corporate governance studies in the economics and financial literature employ agency theory as the dominant theoretical approach involving the casual relationship that links the board characteristics with company financial performance (Hermalin & Weisbach, 2001) . Agency theory (Fama, 1980) is also the dominant theoretical approach applied in board gender diversity and performance studies (Hermalin & Weisbach, 2001). There are three aspects in applying agency theory in board gender diversity studies. Firstly, gender-diverse boards improve the monitoring and controlling function of the management team. Secondly, the essential characteristic of board gender diversity enhances the independent role of the board of directors, in which boards independence is perceived as an important characteristic in mitigating agency problems. Thirdly, gender diverse boards reduce the opportunistic behaviour of the management team by disseminating more accurate information and reduce information asymmetry issue.

The monitoring and controlling functions of the board of directors on the management team play an important role in mitigating principal-agent conflicts. Fama (1980) uses agency theory to link gender diversity with boards' effectiveness in monitoring and controlling the managers to protect shareholders' interest and to minimise the agency costs. Gul et al. (2013) and Adams and Ferreira (2009) also suggest that gender-diverse boards are more efficient in their monitoring activities and more demanding on managerial accountability. Both studies support the argument that gender-diverse boards in weak-governed companies are more effective in monitoring and act as substitute governance in

the context of corporate governance (Adams & Ferreira, 2009; Gul, Srinidhi, & Ng, 2011) . Adam and Ferreira (2009) suggest that board gender diversity improves board inputs and financial outcomes. Their study indicates that gender-diverse boards improve the attendance behaviour of male directors, CEO turnover is more sensitive to stock performance and directors receive more equity-based compensation in gender-diverse boards. Nielsen and Huse (2010b) document that gender-diverse boards are more efficient in monitoring board processes with regards to company strategic decision making and setting policies. Jurkus, Park and Woodard (2011) also suggest that companies with a greater proportion of female directors present lower agency costs, especially for companies in less competitive markets. Based on the 'captured boards' hypothesis introduced by Bebchuk and Fried (2005) the monitoring of female directors reduces a CEO's influence over the non-executive board. This 'captured boards' hypothesis suggests that companies improve their performance as a consequence of the reduction in agency costs.

The independence characteristics of gender-diverse boards reduce the agency costs by performing their duties more diligently than directors that are closer to the management team (Fama, 1980). Carter et al. (2003) also argue that board gender diversity improves board independence because female directors possess different perspectives and experiences that encourage them to ask questions that do not conform to the traditional insiders-controlled boards. Their study suggests that boards with a higher proportion of female directors are more independent than boards with lower female representation. Simpson, Carter and D'Souza (2010) indicate that female directors are more independent as they usually do come from the same background of 'old-boys' network with the same kind of characteristics. Hence they are more independent and serve as a better monitoring mechanism on the management team. Adams, Gray and Nowland (2011) also suggest that gender-diverse boards are more independent as they are not affected by the old-boys' club syndrome.

In addition to the monitoring and controlling function of the management teams, efficient boards also play an essential role in managing information dissemination

and integrated reporting between the management team and the shareholder to ensure that quality and diligent information are disclosed to shareholders at a timely manner. Previous studies suggest that there is a positive link between good corporate governance mechanism and companies' reporting quality (Beekes & Brown, 2006; Christensen, Kent, & Stewart, 2010) . On the other hand, management-controlled boards tend to be involved in fraudulent reporting and abnormal accruals (Davidson, Goodwin-Stewart, & Kent, 2005) . Inadequate and misleading information to the shareholder will give rise to agency conflicts and hence negatively impact on company performance. Gul et al. (2011) suggest that gender-diverse boards are effective in managing the flow of information and create an affluent information environment that improves public disclosures on stock price information. Female directors are also reported to improve earnings quality and mitigate earnings management (Srinidhi, Gul, & Tsui, 2011) . In this instance, efficient boards are able to address the opportunistic behaviour of the management team and mitigate the agency conflicts by reducing the information asymmetry issue, which in turn improve company stock performance.

Despite that gender-diverse boards are perceived as independent and effective monitoring mechanism of the management's activity, female directors are usually a minority in the board of directors. In this instance, if female directors are being marginalised by the majority of male directors, their input may not be fully considered as in-group discussions (Carter et al., 2003). Adams and Ferreira (2009) term the marginalisation of female directors as tokenism and the influence of the token directors on decision-making is low. Board gender diversity may not necessarily enhance board monitoring if female directors are being marginalised.

Although board gender diversity has a positive impact on company financial performance due to the efficient monitoring and effective controlling role, board gender diversity can be detrimental to company financial performance if there is unnecessary over-monitoring (Adams and Ferreira, 2009). The improvement in company financial performance from the monitoring and controlling functions of gender-diverse boards is contingent upon the quality of the company's governance. In well govern companies, over-monitoring and excessive control

from gender-diverse boards can lead to decrease in company financial performance (Adams and Ferreira, 2009). They argue that strong corporate governance can lead to a breakdown in effective communication between boards and managers and may consequently decrease shareholder value (Almazan & Suarez, 2003) . Furthermore, gender-diverse boards may create more conflicts because of disagreement during meetings and differences in opinion (Wellalage & Locke, 2013) . Wellalage and Locke (2013) show a significant negative relationship between gender-diverse boards and company value along with an increase in company's agency costs and suggest that more time and efforts are required to resolve the board conflicts in gender-diverse boards.

In addition, the studies on the implications of boards independence and performance are not conclusive. Ammari, Kadria and Ellouze (2014) and Christensen, Kent and Stewart (2010) suggest that the independence of boards has negative correlation with company performance, while other studies show that the independence of boards has no implication on companies performance (Charles, Redor, & Zopounidis, 2015; Pham, Suchard, & Zein, 2011; Wintoki et al., 2012) . Monks and Minow (2011) argue that equity ownership plays a more critical role in monitoring the management team than the independence of the boards. Although there is a belief that gender-diverse boards are more effective in the monitoring role and increase the independence of boards and consequently improve company financial performance, agency theory does not provide a clear prediction of direction or explanation of any causal relationship between these two variables. Carter et al. (2003) support the over reliance of agency theory in board gender diversity studies and suggest that there is no clear linkage between board diversity and company financial performance from an agency theory perspective. Although Hermalin and Weisbach (2001) agree that principal-agent principle provides many insights from the monitoring role, and independence of boards' function, agency theory is not particularly applicable in board-specific phenomena and there is no clear prediction of the relationship between board gender diversity and performance. The dominant use of agency theory as the premise for investigating the relationship between board gender diversity and performance has resulted in conflicting findings (Ben-Amar, Francoeur, Hafsi, & Labelle, 2013) .

2.2.2 Resource Dependence Theory

The dominant use of agency theory may cause conflicting findings in the diversity-performance study. Carter et al. (2010) argue that resource dependence theory provides a more convincing business case for board diversity. Resource dependence theory is developed by Salancik and Pfeffer (1978) who indicate that companies operate in an open system in which the success and survival of the business is dependent on the external environment and resources. The proponents of resource dependence theory suggest that boards of directors provide an important link between a company and its resources and environmental dependencies. For example, Pfeffer and Salancik (2003) indicate that boards of directors provide four essential resources to companies. These resources are: directors provide useful information to facilitate company's strategic decision-making process; directors act as an important channel for communication to external parties; directors establish network and connection with other companies and institutions, and directors also help to legitimise the companies. From the social network viewpoint, directors are classified into insiders, business experts, support specialists and community influential role (Hillman, Shropshire, & Cannella Jr., 2007) . Hillman et al. (2007) define insiders as current or retired employees of the company; business experts are executives and officers of other public companies; support specialists are professionals in law firms, banking industry, accounting and consulting firms; community influential are leaders in academia, government department and non-profit organisations. As different directors provide access to different resources for a company, gender-diverse boards expand the profiles of the boards and create possible links with critical internal and external resources. Gender-diverse boards also improve the relationship between the companies with its customers, suppliers and competitors, enhance the board's knowledge to the industry and access to the availability of finances and other external resources that benefit a company compared to boards with all male director.

The function of the boards is to provide a linkage between the company and the external environment in order to create economic benefits (Pfeffer, 1972). Hence,

boards are required to attain a mix of skill sets, knowledge, experience and expertise in various areas to create a competitive advantageous environment for the organization (Hillman, Shropshire, & Cannella Jr., 2007; Kiel & Nicholson, 2003). Given the advantages of board diversity, numerous studies that have evolved from the resource dependency theory and conclude that heterogeneous boards enhance the value of companies by creating a competitive advantage environment within the board of directors. Erhardt, Werbel and Shareder (2003) suggest that heterogeneity in board composition leads to better decision-making due to a more excellent knowledge base and innovation. This leads to competitive advantage for the organisation. Chen and Tjosvold (2013) also suggest that cognitive conflicts in diverse group discussions create innovative solutions. High quality decision-making process influences the governance outcomes positively and consequently positively affects the companies' financial performance.

With reference to the four essential resources as mentioned by Pfeffer and Salancik (2003), female directors with different perspectives, skills, knowledge, experiences and behaviour will bring different beneficial resources and useful information to the company. These critical and unique resources of female directors can be different from their opposite counterpart especially in diverse environments and useful to deal with market uncertainty. The additional resources that female directors bring to the boards may facilitate boards' decision-making process and open up opportunities for companies to penetrate markets more effectively. Geiger and Marlin (2012)suggest that gender-diverse boards enhance overall board expertise and improve the companies' linkages with external environment and resources. Pfeffer and Salancik (2003) also suggest that the boards of directors also act as a channel for communication between the company and the external parties to establish network and connection with other companies and institutions. As important information is transferred between companies or external institutions through boards of directors, gender-diverse boards are beneficial in obtaining and communicating information between external resources, stakeholders and the internal management (Hillman et al., 2007).

In view of the benefits of heterogeneity boards, female directors in gender-diverse boards bring to the table important skills, various perspectives of life and knowledge and a different set of competencies and behaviours that contribute to better board discussions and processes. Differences in traits of directors imply that the directors will behave differently and this will have implications on how directors interact with each another, their risk appetite and level of ethical concerns. Female directors are found to set a higher ethical value relative to personal interest in the decision-making process (Bart & McQueen, 2013) . The dynamic of heterogeneous boards' discussions and processes will change as female board representation increases.

Robinson and Dechant (1997) also suggest that workplace diversity improves the competitive advantage of a company. They propose four propositions that support diversity as enhancing companies' value. First, more diverse companies are able to capture the change in diverse demographics and penetrate potential markets. Second, diverse companies are more creative and innovative. Third, diverse companies allow more perspectives to be evaluated during the decision-making process, which enhances problem solving. Fourth, diverse companies have more global perspectives and are more sensitive to differences in international environment. As gender diversity is one of the attributes concerning the general demographic diversity, it also indicates that gender-diverse boards also can improve companies' competitive advantage and financial performance that is especially critical in the current global and diverse economy.

To enhance the competitive advance of a company and penetrate the diverse demographic of the market, Mclnerney-Lacombe, Bilimoria and Salipante (2008) indicate that female directors are usually the agent of change in a corporate environment. Female directors tend to be younger than male directors and are more open to new concepts and ideas when dealing with business. They also tend to create unique links between the company's strategy and to the labour and product markets. This leads to more creative and innovative board decisions where creative and innovative companies tend to outperform other competitors. McInerney-Lacombe et al. (2008) also suggest that female directors positively

influence the board dynamics by changing the boards' communication and interpersonal interaction. This improves boards' creative and innovative decision-making and consequently leads to better company financial performance.

Gender-diverse boards are able to maximize the benefit from the mix of skills in their decision making process. Companies face a serious loss if they do not capitalise on the pool of female's talent in gaining competitive advantage. Kiel and Nicholson (2003) term this mix of skill set as the intellectual capital theory. The effective integration of skill and knowledge is the major determinant of value-add that gender-diverse boards bring to the companies (Kiel & Nicholson, 2003) . Diverse boards are able to improve information flow to managers, produce unique information in the decision-making process and provide access to important constituencies for external environment linkage (Carter et al., 2010). This also indicates that gender-diverse boards are more likely to have a pool of diverse talent from the human capital theory perspective. Overall resource dependence theory supports the notion that board gender diversity improves overall company financial performance by utilising the essential internal and external resources.

2.2.3 Human Capital Theory

The human capital study of Becker (1964) reveals that the enhanced cognitive and productive abilities of each individual's cumulative education, skills and experiences benefit the organisation human intellectual property. The board of directors consists of a group of highly capable people who possess a broad range of knowledge, experiences, skills and values. The cognitive and productive abilities of the directors allow them to seek and interpret information that influences the effectiveness of board decision-making and processes, and ultimately influences overall company performance.

In the general population, the recent statistics in Europe and the U.S. shows that females outperform males in university graduates and the employment rates of young females exceed the older generation[12]. In Australia, the proportion of

[12] Bureau of Labor Statistics. (2012). Current employment statistics. http://www.bls.gov/ces.

females who attained a bachelor degree or higher is 39.6% compared to the proportion of male graduates at 30.4% (WGEA, 2018). In relation to board gender diversity, Singh, Terjesen and Vinnicombe (2008) in their study reaffirm these statistics and conclude that female directors of FTSE 100 firms in the UK are more likely to have an MBA degree with international experience. These statistics suggest that females have attained a similar level of education as to their male counterparts and are able to contribute their knowledge into the workforce. Simons, Pelled and Smith (1999) support the educational attainment of management teams, and agree that cognitive diversity has positive implications on company financial performance.

Farrell and Hersch (2005) suggest that female directors with their increase cognitive and educational attainment level provide diverse perspectives and engage in more productive discussions. With their different experience and values in life, they ask different sets of questions and contribute positively to overall group performance. The dynamic interaction in the gender-diverse boards offers diverse perspectives in understanding and dealing with a complex business environment as well as to solve specific problems. This allows the diverse board to be more effective in the board decision-making process (Nielsen & Huse, 2010a) .

Despite cumulative educational attainment enhancing the cognitive level of each individual; the cognitive and productive abilities of each director differ depending on their experiences, skills and values (Hambrick, Cho, & Chen, 1996; Hambrick, 2007; Hsu, Kuo, & Chang, 2016) . Hillman and Daiziel (2003) suggest that high educational level of female directors provides additional human capital, which is regarded as relevant business assets to a company. Terjesen et al. (2009) indicate that different genders bring in unique human capital onto corporate boards. However, they also indicate that there could be a negative impact for gender-diverse boards because females may not possess the similar corporate experience to men even though they are compatible with men from education qualification perspective. They argue that although females have developed impressive human capital, they may not have the “right” kind of human capital that fits in to be a director of a company due to lack of business experience. Simpson

et al. (2010) also support this argument indicating that female directors are less likely to have a strong background in business management than men and do not have sufficient experience in the high-level business positions. Although this prior literature suggests that human capital theory supports female directors add value to boards' human capital, however if females do not possess appropriate experiences and exposures as required to be board ready, it could limit female advancement to corporate boards and may have negative impacts on company financial performance.

Another stream of literature suggests that higher levels of education and academic attainment of female directors lead to emotional conflicts in board decision-making processes that may negatively affect company financial performance (Arena et al., 2015; Smith, Smith, & Verner, 2006) . Petrovic (2008) suggests that female directors who possess higher education levels with relevant skills and experiences are more likely to impose their ideas that lead to relationship conflict in board discussions. Lau and Murnighan (1998) also indicate that although gender-diverse boards improve critical thinking of boards, it may cause decision making to be less effective as the decision-making process is slower due to conflict of opinion in gender-diverse boards. The conflicts and disagreement in board discussion can cause tension and annoyance among board members that lead to ineffective board processes and negatively impact company financial performance(Arena et al., 2015). The costs of resolving conflicts and getting consensus in the boards are generally value destructive and outweigh the benefits (H. Nguyen & Faff, 2007) . This will lead to ineffective board discussions and consequently negatively impact the overall performance.

2.2.4 Gender Differences Theory

This study applies the famous quote from Gray (1992) "Men are from Mars and Women are from Venus" and recognises that males and females are different in their behaviour and leadership role, as there exist gender differences between them. Eagly, Johannesen-Schmidt, & Van Engen (2003) identify the leadership role of men as argentic characteristics and women as communal characteristics. Male leaders with argentic attributes are more assertive, aggressive and self-

confident. Whereas female leaders with communal attributes are more concern with the welfare of other stakeholders, speak tentatively, more democratic and participative, less autocratic and directive in the workplace (Eagly et al., 2003) . In relation to female board representation, this theory implies that female directors with different experiences in working and non-working lives behave differently than their counterparts. These intrinsic characteristics of female directors add-value to the male-dominated boards by offering different perspectives. Furthermore, diverse boards are more effective in handling a variety of different natured tasks (Eagly, Karau, & Makhijani, 1995) . The different skills of female directors facilitate the board tasks in diverse areas and enable the board to understand the marketplace from a broader perspective. Furthermore, the differences in values and cognitive between genders may also influence the decision-making process and how decision are made. Van Ginkel and Van Knippenberg (2008) demonstrate that gender-diverse groups engage in more in-depth discussion compared to the boards with all male groups. Adams and Funk (2011) also suggest that more collaboration among directors in gender-diverse boards to extensively discuss and integrate information in the decision making process. However, a study by Yukl (2002) reveals that there are no overall differences in effectiveness between males and females although they do have some differences in skills set and behave differently in some situations.

For the risk-taking perspective, it is a general consensus in psychology and economics studies suggesting that females are more risk adverse than males. In a meta-analysis of 150 studies, Byrnes, Miller and Schafer (1999) exhibit that females make a less risky choice than males and are less likely to involve in risky experiment and gambling. Females also make a more conservative choice in investment decision (Bernasek & Shwiff, 2001) . However, the samples of these two studies are based on the risk-taking attitude of the general population. Deaves, Lüders, & Luo (2009) in a study uses a sample of students from economic, finance and business studies, indicate that females who involve in male discipline can be different from the general population. This study finds that the confidence level of female students is similar to male students, indicating that females who expose to similar education and experience background are not less

confident than males. In this context, female directors in the corporate environment can also adapt to the male-dominated environment. This is demonstrated in Admas and Funk's (2011) study, suggesting that female directors are more risk-taking than male directors once they break through the glass ceiling in the corporate environment. Therefore, having female directors on boards does not necessarily lead to more risk-adverse decision-making. Using more advance econometric techniques to address the endogeneity concern in board gender diversity studies, Sila, Gonzalez and Hagendorff (2016) find no evidence that female board representation affects the company equity risk. Powell (1990) also suggest that gender difference is minimal at top-level management settings believes that females who pursue the non-traditional high-level career at board level have values and leadership styles that are similar to male counterparts, rejecting feminine stereotyping. This is supported by Kanter's (1977b) organisational behaviour arguments, suggesting that males and females at the same organisational level behave very similarly. On the contrary, Post and Byron (2015) in their meta-analysis of 140 studies suggest that female directors are more risk adverse than male counterparts and geared towards more sustainable investment. With these two contradictory arguments, if there exist general differences in risk behaviour between the genders when boards comprise of mixed of male and female directors, it could be the board gender composition that affects the risk-taking behaviour of the company.

2.2.5 Group Effectiveness Theory

Group effectiveness theory suggests that boards with a particular composition may be more effective compared to other boards as different nature of tasks required a different mix of talents (Gladstein, 1984). Similarly, in the context of boards of directors, board's gender composition affects group effectiveness. Nielson and Huse (2010a) in their study find that in the context of female directors' contributions to corporate boards, critical decision-making based on the interaction and exchange of information are critical attributes to board effectiveness. Studies in the diversity of perspectives also suggest that heterogeneous boards are more effective than homogenous boards in implementing changes and solving problems (Bantel & Jackson, 1989) . This suggests that board gender diversity with the

different personality and human capital resources improves the perspectives in decision-making, increases networking boundary and creativity. A panel study from 1992 to 2006 of Fortune 1500 companies suggests that by adding a female to the top management team improve companies' Tobin Q and share price (Dezsö & Ross, 2012) . However, the positive implications of gender-diverse boards on board effectiveness can potentially have disadvantages when the heterogeneous boards take longer and more effort to come to consensus. A study by Earley and Mosakowski (2000) suggest that boards with all male directors are more cooperative as there is less emotional conflict within the group. Wellalage and Locke (2013) also find a negative impact of gender-diverse boards on company value due to boardroom conflicts that required more time and effort in getting agreement on company strategic decision-making. This slows responsiveness and delays actions needed to react to competitors initiative in a highly competitive environment (Hambrick et al., 1996) .

2.2.6 Tokenism And Critical Mass Theory

The theory of tokenism was initiated by Kanter's ground-breaking seminal work (Kanter, 1977a) and it underpins the concept of critical mass theory in the board gender diversity literature. Kanter develops tokenism and critical mass theory in organisation behaviour concerning organisation power structure, the opportunity for advancement and more importantly the relative numbers of a social group according to the observable characteristics, either gender or race. She describes her study as an ethnography of a corporation that dissects the corporate life in details. She indicates that organisations are dominated by masculine principles. This phenomenon produces organisational contexts that are gendered with an implication of the token member, generally female in context and is found to be dysfunctional in the organisation.

A token in the board gender diversity context refers to the single female director that is treated as the representation of their category. Kanter indicates that the sole representation of a female on top management and board level as "tokens", and to some extent as "solos" in the extreme cases (Kanter, 1977b). The contribution of the token female director is usually limited as she is denied from full

participation on decision-making. In some cases, the appointment of token female directors is to comply with the legislative requirements on gender quotas. Applying this to the top management of the corporations, the tokenism dysfunction of an organisation affects the practices, norms and values that shape the low representation of females on boards. The example of tokenism is demonstrated in the failing of Enron's case where the annual report of Enron in 1998 showed that there is only one female director sitting on the board that consists of seventeen directors. In this instance, the impact of the token female director that can contribute to the board's oversight function can be minimal (Erhardt et al., 2003).

Kanter notes that the image distortion that leads to the sex-role stereotype of female leaders is inconsistent with general perception. She explained that females in organisations usually possess lower ranked position with fewer opportunities. Based on her study of behavioural consequences of power and opportunity structure, she found that males in lower power and low opportunity positions behave like females in the similar or same ranking and position. The general perception argues that females are being identified as communal rather than possessing the qualities of leadership. However, Kanter argues that it is the structure, not the gender that explains the difference.

Kanter's theory evolved from the classical analysis of absolute numbers and developed the critical mass theory concerning the importance of relative numbers. She argues that a "significant" proportion of female representation has to be reached in order to make their voice heard and make a difference in decision-making on boards. She constructed four categories of the group with the basis of relative numbers based on the composition of male and female representation of the group. These groups are:

i. Uniform groups – Homogenous groups where the members of this category share the same characteristic, e.g., boards that consist of all male directors.
ii. Skewed groups – Groups with a minority of less than twenty percent.

iii. Tilted groups – Groups consist of at least twenty percent minority but less than forty percent.

iv. Balanced groups – Groups consist of at least forty percent of the minority.

(Note: In board gender diversity studies, the minority refers to female directors)

Among all the groups as mentioned above, skewed groups are perceived as the problematic groups because the minority, female directors in board gender-diversity scenario, are identified as token and prone to be stereotyped by the male-dominated groups (Joecks et al., 2013; Kanter, 1977b). The token female director or the minority female directors in the male-dominated boards are unable to express their views to influence the group discussion. When the minority in the skewed groups increased in the relative proportion toward tilted groups and balanced groups, their presence is identified as a distinct group (Torchia, Calabrò, & Huse, 2011) . The representation of the minority in tilted groups and balanced groups are able to bring in their knowledge, skills, values and perspectives to contribute to the group discussions and improve the effectiveness of board strategic formulation and processes.

However, the question remains on what is the effective number or proportion of female representation on boards to make a difference; even it is still a minority in the group. Extending from this tokenism theory, Kristie (2011) posits that “one is a token, two is a presence and three is a voice”. Konrald et al. (2008) also support this quote and indicate that the magic number of three seems to gain more momentum in board decision-making, and female directors are no longer to be seen as outsiders. Based on this critical mass theory, previous empirical studies suggest that the critical mass of female directors is reached when there are at least three female directors on boards (Erkut, Kramer, & Konrad, 2008; Konrald et al., 2008) . Dahlerup (1988) indicates that thirty percent is the relevant representation for the minority group to make a difference. Torchia et al. (2011) also suggest a positive and significant relationship between the critical mass of female directors and company innovation and board strategic tasks performance

when there are at least three female directors on boards. Campbell and Mínguez-Vera (2008) also found a positive effect between the critical mass of the proportion of female directors and company financial performance. However, their study shows that the presence of one or two female directors on boards has an insignificant impact on company financial performance.

Joecks et al. (2013) examine the relationship between gender diversity and company financial performance using critical mass theory. Their study suggests that gender diversity has a negative impact on company's return on equity before a critical mass of thirty percent of female directorship has been reached. Once the female representation passes this critical level, increase in gender diversity level is associated with higher company performance. They suggest a U-shape relationship between gender diversity and performance.

Drawing from tokenism and critical mass theory, it indicates that boards need to achieve a "significant" proportion of female board representation, that is "the critical mass" of female directors on boards, in order to have more pronounced impacts on company financial performance. Without the critical mass of female board representation, female directors' contribution is limited by being the token on boards. The dominant-male groups on boards will marginalise their inputs, consequently diminishing the impact of gender-diverse boards on company financial performance.

2.3 Literature Reviews

In a rational economic environment, companies are expected to maintain good financial and market performance within the going concern principle and to maximise the stakeholders' expectations. Many positive relationships between board gender diversity and company financial performance have been posited in the popular press[13]. The Council in its 2010 Corporate Governance Practices and Recommendations state that "Research has shown that increased gender diversity on boards is associated with better financial performance, and that improves

[13] ASX 500 - women leaders. (2011). Retrieved from http://www.reibeyinstitute.org.au/research/research/

workforce participation at all levels and positively impacts the economy". However, these claims have not been supported conclusively in academic studies. Previous empirical studies suggest mixed evidence between female's participation on corporate boards and company financial performance, including assertions of positive correlations between board gender diversity and company financial performance (Bonn, 2004; Carter et al., 2003; Erhardt et al., 2003; Francoeur, Labelle, & Sinclair-Desgagn, 2008; H. Nguyen & Faff, 2007; Ntim, 2015) , negative correlations (Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Bøhren & Strøm, 2010) or no significant relationships (Carter et al., 2010; Dezsö & Ross, 2012; Rose, 2007) of gender-diverse boards on performance.

Four main reasons contribute to diverse conclusions of previous studies. First, data drawn from different cultures operating in different jurisdictions and institutional contexts prevents consistent research findings. Depending on legal provisions in different countries, a two-tier corporate governance system allows separation of board tasks and roles between management board and supervisory board [14] . In comparison, the board of directors in a single-tier corporate governance system determines corporate strategy unitarily [15] . The impact of gender diversity on company financial performance depends on the type of board governance. Adam and Ferreira (2009) argue that in well-govern boards, over-monitoring from gender-diverse boards leads to counter-productivity and hinders effective decision-making. The findings of previous diversity-performance studies may vary due to differences in regulatory requirements, governance structures and economic climate.

Second, studies examining corporate governance characteristics and performance are plagued with endogeneity issues (Bota-Avram, 2013). The relationship between gender diversity and company financial performance appears to be jointly endogenous (Carter, D'Souza, Simkins, & Simpson, 2010). It is difficult to control the reverse causality between these variables and the possibility of omitted variables in any structural models. Furthermore, applying a valid external

[14] Examples of countries that practice two-tier corporate governance system are Germany, Norway, Finland, the Netherlands and China.

[15] Examples of countries that practice single-tier corporate governance system are the U.S., the U.K., and Australia.

instrumental variable required to fulfil two fundamental conditions, which is challenging to ascertain the validity and relevancy of the external instrumental variable. A relevant external instrumental variable needs to be correlated with the problematic explanatory variable whilst at the same time needs to be uncorrelated to the error terms of the dependent variable. Finding a valid external instrumental variable is a challenging task. The existence of the endogeneity problem can lead to unreliable findings if the issue is not being addressed appropriately. The methodology section in chapter three of this study provides further elaboration on the endogeneity issue and present various econometric methods available to deal with this concern.

Third, various measurements of diversity and performance using different time-frames may also explain the conflicting results. Proxies to measure gender diversity include the presence of females on boards, proportion of female directors and Blau's diversity index (Sampson, 1984). Performance measures comprise common accounting performance, return on assets (ROA) and return on equity (ROE), and market measures such as book-to-market value, Tobin's Q and market capitalisation. Moreover, focusing on short-term measures of performance may not capture the impact of gender diversity. Lack of long-term analysis and the understanding of the implications of gender diversity may result in unsustainable policy implementation. For example, studies using cross-sectional data, focusing at one or two points in time, suggest that gender-diverse boards out-performed homogeneous boards (Carter et al., 2010; Erhardt et al., 2003). While studies using panel data over a period of time generally show no implication or negative effects of having more female representation on boards (Farrell & Hersch, 2005; Rhode & Packel, 2014; Rose, 2007; Smith et al., 2006) . This suggests that examining the effect of female on boards based on cross -data can be spurious, meaning that there exists a self-selection bias where successful companies tend to appoint more females onto their boards (Farrell & Hersch, 2005; Ryan & Haslam, 2005) .

Finally, applying different statistical methods in analysing the relationship between the corporate governance characteristics and company financial performance has

also led to inconclusive findings in previous studies. Previous literature in the gender diversity and corporate governance studies generally apply ordinary least square method, fixed effect estimation, the two-stage-least-square method with instrumental analysis and lately generalised method of moments analysis in examining the relationship between board diversity and performance. Depending on the statistical method used in the literature, the results may vary and are not consistent throughout each method.

This following section reviews the previous empirical literature that examines the relationship between gender-diverse boards and the company performance. We categorise the studies into three main streams; studies that support gender-diverse boards with positive implications, studies that suggest a negative correlation between gender-diverse boards and company performance and studies that do not support either positive or negative implications of having gender-diverse boards on company performance.

2.3.1 Studies Supporting Gender Diversity And Company Performance

Media and supporters of boards' gender diversity often cite Catalyst (2007) and McKinsey (2007) reports despite the statistical shortcoming in these studies. Catalyst (2007) examines US's Fortune 500 company financial performance and ranks the companies according to the proportion of female directors on boards. The results from the univariate analysis of the sample indicate that the companies in the highest quartile performed better than the lowest quartile in return on equity (ROE), return on sales (ROS) and return on invested capital (ROIC). McKinsey Report (2007) comprising two studies, a qualitative study that surveys 115,000 employees to inquire if companies with women in top management perform better than companies without women in top management; and a quantitative study on 89 European listed companies with the best diversity score against the industry average. The quantitative study contained in the McKinsey Report (2007) shows that more diverse companies performed better in terms of ROE and operating results, earnings before interests and taxes (EBIT) against the average of their industry. However, both studies compare the means of the study groups without taking into consideration other control variables. Therefore, it is unable to

empirically show the correlation between female board representation and company financial performance or be able to imply if there is any causal relationship. Both studies also did not report if there is any significant test being carried out on the differences of the means of the sample. Furthermore, McKinsey's Report (2007) also suffers from sample selection bias as the sample is based on The Amazon Euro Fund's criteria, the funding organisation in the study.

In academia, early empirical evidence of the positive relationship between board diversity and company financial performance is provided by Carter et al. (2003) and Erhardt et al. (2003) . Carter et al. (2003) studied Fortune 1000 companies and find a significant positive relationship between percentage of females on boards and firm value measured by Tobin's Q. Erhardt et al. (2003) studied a smaller sample of the 127 largest US companies from 1993 to 2002 and find a positive association between gender-diverse boards and performance measured in ROA and ROI. Erhart et al. (2003) suggest that the improved company financial performancefor gender-diverse boards is associated with effectiveness in the oversight function of the boards where gender-diverse boards offer a broader range of opinions. This is consistent with the agency theory suggesting that effective monitoring function of gender-diverse boards on the management team that leads to the improvement of company financial performance.

In line with resource dependence theory, prior literature also suggests that board gender diversity improves market competitive advantage. Female directors provide an essential link between the company and its external environment that facilitate the company in securing critical resources and enhance market valuation (Francoeur et al., 2008; Lückerath-Rovers, 2013; Ntim, 2015). Richard (2000) supports the essential link of gender-diverse boards with internal and external resources. He suggests that board gender diversity encourages workforce diversity; especially talented female employees; and enhances company competitive advantages with innovation and board effectiveness that leads to better company performance. Miller and Triana (2009) also demonstrate that gender-diverse boards enhance company's good reputation and improved

innovation. These are the mediators that positively affect company financial performance.

In Australia, there are few studies that examine the relationship between gender-diverse boards and performance. Bonn (2004) examines manufacturing companies from 1999 to 2003 and suggests that although the average females representation on boards is lower than five percent during the study period, the ratio of female directors is positively associated with company performance, measured in return on equity and market-to-book ratio. They argue that because the selection criteria are more stringent for females to join the boards, female directors possess exceptional attributes and qualifications that significantly affect the company financial performance in a positive way. Nguyen and Faff (2007) examine the top 500 public listed companies in Australia from 2000 to 2001 and suggest that both the presence of female directors on boards and the proportion of female directors on boards promote shareholders' value and it is associated with a higher market value of the company. However, They suggest that board gender diversity should be promoted as a common corporate governance practice. An important point to consider in these two studies is the application of OLS estimation in examining the correlation between board gender diversity and company performance. Bonn (2004) uses simple regression analysis without taking into consideration the endogeneity concern in the diversity-performance study. Nguyen and Faff (2007) attempt to address the endogeneity concern using 2SLS estimation. However, the results from OLS and 2SLS estimations are highly similar, and they suggest that the OLS estimations are not affected by the endogeneity issue. It is plausible that the positive correlation between female representation on boards and company financial performance can be a reliable inference in explaining the causality relationship, as both board gender diversity and company financial performance are endogenously determined (Carter et al., 2003; Farrell & Hersch, 2005; Martin-Ugedo & Minguez-Vera, 2014) .

The most recent study of the relationship between gender diversity and performance in the Australian context is by Strydom, Au Yong and Rankin (2017). They draw from Kanter's critical mass theory (Kanter, 1977a) and suggest that all-

male and skewed boards have a lower earnings quality compared to more balanced boards that are comprised of at least twenty percent of female directors. This result is consistent with Joecks et al. (2013), where they suggest that female directors have limited opportunity to affect company financial performance until the critical mass of thirty percent of female board representation is achieved. The critical mass of female directors on boards breaks through the acceptance barrier on boards and creates a more supportive atmosphere, consequently increasing collaboration among the board members and positively impacts the dynamics in the boardroom. Their observations also reveals that female directors are superior monitors that constrain earnings management on financial reporting, leading to improved earning quality and lower stock price volatility.

Campbell & Mínguez-Vera (2008) use the sample of Spanish non-financial listed companies in their study and show a positive effect of percentage of females on boards on companies' value as measured by Tobin's Q. Consistent with resource dependence theory, they argue that gender-diverse boards are more creative and innovative as the diverse boards provide a wider spectrum of perspectives and wider range of knowledge and skills. The image of gender-diverse boards has positive impacts on customer behaviour, and this enhances competitive advantage and sets a strong foundation of a company in the marketplace (Campbell & Mínguez-Vera, 2008) . They also suggest that gender-diverse boards are more effective in their monitoring role and improve company performance. However, this study indicates that merely examining the presence of females on boards has an insignificant impact on the company financial performance. It is rather the relative proportion of female directors on boards has a positive impact on company financial performance. Another study by Campbell and Minguez-Vera (2010) examines the market reaction on the appointment of female directors and found that the share price movement is positively correlated to the announcement of the appointments of female directors. This implies that investors do not penalise companies with increased female board representation. They further indicate that the economic gains and the reaction of the overall market for gender-diverse boards were sustained over a period of time. They suggest that the legislative

change in Spain makes economic sense and assists females' advancement to board level.

Reguera-Alvarado, Fuentes and Laffarga (2017) study the most recent development of board gender diversity in Spain after the implementation of mandatory gender quotas on boards in 2015. They suggest that the mandatory laws in Spain on board gender diversity have improved the appointment of female directors on boards and the increment of female board representation is positively correlated to higher economic results. Gender-diverse boards open up the board dynamics with new ideas and skills from different perspectives that lead to the increase in company values, consistent with resource dependence theory. The positive correlation between female board representation and company financial performance is in-line with Martin-Ugedo and Minguez-Vera (2014) study that examine Spanish small and medium-sized enterprises (SMEs) from 2003 to 2008. This study also suggests that gender diversity and performance is endogenously determined where females tend to serve in better-performing companies and companies with higher performance are more likely to add females to the board (Farrell & Hersch, 2005) .

A recent study based on a US sample of 3000 companies from 2007 to 2014 by Conyon and He (2017) suggest that the presence of female directors on boards has a positive effect on company performance. Applying threat-rigidity and job sorting and matching theories, this study argues that gender diversity is not constant across the performance distribution. The results from the quantile regression methods show that the positive impact of female directors on boards is larger in high-performing companies relative to low-performing companies. They argue this is due to the threat posed by declining performance in low-performing companies as suggested by threat-rigidity theory, the unique perspectives and experiences of female directors are less likely to be utilised as there is a strong pressure toward uniformity of ideas and opposition to expression of directors opinion. On the other hand, there is less pressure to suppress ideas of female directors in well-performed companies and consequently better utilisation of their knowledge, expertise and perspectives.

Gender-diverse boards also demonstrate more effective risk monitoring and dealing with unstable economic conditions during a crisis. Adams and Ragunathan (2017) study large publicly traded US banks and find that banks with more diverse boards have better financial performance especially in crisis situations. They suggest that females in finance careers have the same average level of risk-aversion as males, and more gender diversity is not necessarily associated with less risk. The study shows that the listed banks with more gender-diverse boards did not engage in fewer risk-taking activities around the crisis. This indicates that generalisation of gender differences with their preference risk-profile with the general population to the top management level can be stereotyping. They attribute the banks with gender-diverse boards perform better than other banks, as male directors in the gender-diverse boards have fewer attendance problems and female directors performed different committee duties on boards compared to male directors.

Sabatier (2015) examines French companies listed on the CAC40 index and suggests that board gender diversity is not an exogenous variable. It strongly depends on firm attributes where the number of board directors is negatively correlated with board gender diversity. This study also finds that board gender diversity is strongly influenced by companies' previous gender diversity and gender diversity in connected boards. The increased in the appointment of female directors during 2008 to 2012 contributed to better company financial performance, measure in ROA, ROE and Tobin's Q. Furthermore, companies that promote gender diversity reduce company inefficiencies and approach their optimal performance level. The data of this study does not show the risk of tokenism of female directors because most of the observed companies have exceeded the critical threshold of three female directors on boards.

In line with the improvement of overall company financial performance and public confidence from the increment of female board representation, investors also react positively to the appointment of female directors and perceive that gender-diverse boards add value to the overall governance structure. Gordini and Rancati (2017)

study of public listed companies in Italy from 2011 to 2014 supports the argument that the greater gender diversity on boards generates economic gains and does not destroy shareholders' value. They suggest that companies should focus on the right mix of male and female directors and demonstrate that simply appointing one female to show the presence of the female on boards has no significant effect on company performance. Kang, Ding and Charoenwong (2010) suggest that companies with good business and corporate reputations have a lower cost of debt and this has a positive effect on the profitability of the company. They suggest that investors respond positively to the appointment of female directors and are more receptive when the female directors are independent directors in Singapore companies.

Public perception of company image and good corporate governance in place is a topical debate in the current economic conditions. High quality and accurate financial reports and transparency in corporate governance practices are essential in creating a good workplace culture. Previous studies also reveal that gender-diverse boards improve public confidence by displaying higher quality corporate governance practice. The integrity and credibility of corporate disclosures give confidence to the public about the transparency of corporate governance practices. Gul, Hutchinson and Lai (2013) in their study of 2200 US companies, suggest that board diversity adds to transparency and there is a positive relationship between gender diversity and analysts' earnings forecast accuracy. This study suggests that gender-diverse boards make more informed and accurate disclosure that assists in more accurate analysts forecast. Their study supports the hypothesis and suggests that board diversity improves the transparency and accuracy of financial reporting. Another study by Gul, Srinidhi & Ng (2011) also shows that gender-diverse boards in large companies are more transparent in their disclosure and hence improve the credibility of publicly available information. This indicates that gender-diverse boards are more diligent in terms of public disclosure and have a higher quality of financial reporting. In addition, females serving as the chief financial officer also reduce the discretionary accruals in financial reports, more conservatism and managerial opportunism that lead to

more accurate financial reporting and good corporate governance practices (Peni & Vähämaa, 2010) .

On the other spectrum and inline with current social and ethical concerns globally, companies should not focus solely on company profitability and the shareholders. There is a shift of corporate responsibility toward overall stakeholders of the society. Given current investment trends that are geared toward social responsibility investment, Bear, Rahman and Post (2010) indicate that investors and analysts are considering the existence of boardroom gender diversity as a positive investment variable when making an investment decision. The positive market opinion commends of these analysts to encourage the market to invest in companies that commit to social and ethical responsibility, and consequently this leads to a higher demand of shares and the increment in share price and market values (Reguera-Alvarado et al., 2017) . The social, ethical and accountability concerns have become more relevant in the recent economic trend of good governance and corporate reputation. Female directors are perceived to posses communal attributes that are more concern with the welfare of other stakeholders (Eagly et al., 2003). The inborn characteristics of female directors influence boards decision-making and processes with different perspectives and value. Gender-diverse boards pay more attention to ethical concerns that enforce ethical behaviour of the company and support good corporate governance practices (Labelle, Gargouri, & Francoeur, 2010) . Nadeem et al. (2017) also show a significant positive relationship between gender-diverse boards and corporate sustainability practices. When board gender diversity is well managed, it enhances not only board strategic decision making but also sends a positive public image by conveying commitments to equal opportunity and inclusion (Rhode & Packel, 2014) .

The discussions so far focus mainly on the board gender diversity of developed countries. However, the board characteristics and governance structure between well-developed countries can differ compared to countries in the transition phase or under-developed economy. Cultural differences, government regulations and business practices are the main contributors to the difference in board structure

and governance systems. There is another stream of literature that examines board-gender diversity in these transitional economies and under-developed countries. Nguyen, Locke and Reddy (2015) examine the 120 public listed companies in Vietnam from 2008 to 2011 and find that board gender diversity has positive effects on company financial performance, Tobin's Q. They suggest that boards with at least one female director outperform boards with boards with all male directors, and boards with at least two female directors perform better that boards with at least one female director. The positive impact on performance is attributed to the additional monitoring of gender-diverse boards in weak-governing companies in the Vietnamese context. Agency theory is well applied in this context as board gender diversity improves the monitoring function of boards in weak-governing companies and hence company financial performance.

Liu, Wei and Xie (2014) study the public listed companies in China from 1999 to 2011 and suggest that board gender diversity is positively correlated with company financial performance, measure in ROA and ROS. They emphasise that the participation in the daily operation of female executive directors is more important than the monitoring role of the independent female directors, and it has stronger effects on company financial and operation performance. Consistent with resource dependence theory, they argue that female executive directors have more useful connections and communication channels that lead to a stronger impact on company performance. This study also suggests that the underdeveloped corporate governance system in China also benefit from the monitoring role of female directors to improve the quality of board deliberations on complex issues and reducing the probability of major decision missteps. Another important finding of this study also reveals the impact of tokenism and gender-role stereotypes of the sole female director. This study finds an insignificant impact of sole female director on company financial performance, while it supports the critical mass theory and suggests that boards with at least three female directors have a stronger impact on company financial and operation performance.

From a national and global perspective, Post and Byron (2015) in a meta-analysis of 140 studies suggest that female board representation is positively correlated in

countries with better shareholders protection and culture with gender parity. In this context, they find that stronger shareholder protection provides a better ground for companies to utilise the talent, knowledge and experience of female directors. With a gender parity mentality, the society enables females to acquire appropriate human capital and produce a higher quality of female directors that contribute to the overall company performance. Investors value the social differences in human capital and positively evaluate the future earnings potential of companies with more female representation. Another multi-territory study on Asian countries by Low, Robert and Whiting (2015) suggest that increasing numbers of female directors on boards has a positive effect on company financial performance. However, they indicate that the positive effects diminished in countries with higher economic participation and empowerment. Mandating gender quotas or forcing the appointments of female director can reduce company financial performance in countries with strong cultural resistance. Terjesen et al. (2016) carry out a meta-analysis of the public listed companies in forty-seven countries, suggest that although independent boards serve as an effective control mechanism on the management team, external independent directors do not contribute to company financial performance unless the board is gender diversified. They also demonstrate that board gender diversity enhances board effectiveness and have better performance measured in Tobin's Q and ROA. Schmid and Urban (2017) use a board dataset of fifty-three countries and find that female directors lead to higher company valuation in more developed countries. The selection process of female directors is more stringent in the developed countries that breakup of the old boys club and glass-ceiling effect. This contributes not only to the positive impact of gender-diverse boards on company financial performance but also over-performance of the female directors who make it to top positions.

In relation to critical mass theory, the theory suggests that female directors need to achieve the critical threshold before they can make a difference on boardroom dynamics and influence the decision-making and processes. Torchia et al. (2011) survey the directors in 317 Norwegian companies and suggest that the critical mass of at least three female directors is the sufficient number for female directors to contribute to strategic board task that leads to improvements in company

performance. Arena et al. (2015) base on 211 European Union public listed companies in the construction industry also suggests that the critical mass of female board representation, rather than the simple presence of the female director on boards, has an incremental benefit on company performance. The critical mass of female directors on boards influences the boards' dynamics in interactions and processes between the male and female directors with positive implications on company financial performance (Erkut et al., 2008; Konrald et al., 2008). Joecks et al. (2013) also suggests that board gender diversity initially has a negative effect on company financial performance until a critical mass of thirty percent of female directors on boards is achieved. The critical mass of female board representation is associated with higher company financial performance compared to boards with all male boards. Kogut et al. (2014) argue that imposing gender quotas is the need to disrupt a structural impediment to permitting an endogenous mechanism to sustain the appointment of female directors beyond a critical mass.

2.3.2 Studies With Negative Correlations Between Gender Diversity And Performance

Despite the positive relationships cited by some previous studies between gender-diverse boards and company performance, some studies do not support the positive implications of having gender-diverse boards and suggest a negative impact of having more female board representation. Earley and Mosakowski (2000) suggest that directors in all male boards are more cooperative than gender-diverse boards, and they appear to have less emotional conflicts. This indicates that directors in gender-diverse boards are less cohesive in board discussions and experiences communication breakdown. Boardroom conflicts arise when there exist different and conflicting opinions amongst the board of directors as suggested in gender differences theory. As such the distinct personality and leadership style of male and female directors can lead to sub-optimal group effectiveness that causes boardroom conflicts. Despite the benefits of gender-diverse boards producing quality board decision-making, in an intensely competitive marketplace where companies are required to react to market changes in a timely manner, the disagreement of gender-diverse boards can

cause the delay in reaching consensus and inefficiency in the decision-making process (Hambrick et al., 1996) .

Adams and Ferreira (2009), study a sample of US S&P 500 companies from 1996 to 2003. Their findings suggest that boards gender diversity is negatively correlated to company financial performance. Although the results of this study suggest that gender-diverse boards add value to company financial performance by improving the monitoring function on companies with lower level governance in place as suggested in agency theory, overall the negative implications on company financial performance is due to excessive monitoring imposed by gender-diverse boards on well-governed companies. For less well-governed companies they are more effective in reducing agency costs and CEO turnover is more sensitive to stock performance. They also find the negative effect of gender-diverse boards on the effectiveness of take-over defences that result in negative company performance. The negative effect of gender-diverse boards is attributed to the increase of company agency cost due to boardroom conflicts that require greater time and effort in getting consensus on strategic decisions (Wellalage & Locke, 2013) . Jurkus et al. (2011) also supports the reduction of agency costs in gender-diverse boards of the Fortune 500 companies only materialised when strong external governance is absent in a less competitive product market.

Bøhren and Strøm (2010) and Ahern and Dittmar (2012) both examine Norwegian companies and suggest that companies create more value when gender diversity is low, and the company's performance deteriorates after the implementation of mandatory gender quotas. Bøhren and Strøm (2010) link the increase of female representation to low company values due to the shortcoming of imposing gender quotas on Norwegian companies. Ahern and Dittmar (2012) also demonstrate that the forty percent mandatory gender quotas on Norwegian companies has resulted in many companies rushing into the appointment of younger and inexperienced female directors, causing the negative impact on company operating performance. These two studies suggest an important finding on imposing mandatory gender quotas and question the ineffective recruitment process that force companies to increase female representation on boards to comply with the legislative

requirements. An important point to note in Ahern and Dittmar (2012) study is the application of the exogenous change to corporate boards from the implementation of the gender quotas as a natural experiment in board structure. They hypothesise that if companies chose the board structure to maximise company value, forcing a company to comply with the new law may lead to a decline in company value, as there is a legal constraint on the choice of board structure. The deterioration in company value measured in Tobin's Q is due to the characteristic of the newly appointed female directors. Although the new female directors are highly educated, they are likely to be employed as a non-executive manager with significantly less CEO experience and relatively younger, substantially different compared to the existing male directors. The analysis also indicates that the companies maintain the optimal board size and companies are forced to replace male directors to comply with the gender quota. This study uses pre-quota variation in female directors as an instrument and finds that the mandatory gender quota has led companies to undertake more acquisition and increase leverage. Interestingly, this finding of Ahern and Dittmar (2014) also in line with a study by Berger, Kick and Schaeck (2014) on Germany's banks, suggesting that younger female executive in banks take on higher portfolio risk.

Some studies suggest that gender-based diversity on corporate boards is a sign of tokenism and limit the contribution of the sole female director (Abdullah, 2014). Minguez-Vera and Martin (2011) attribute the negative impacts of the presence of the females on boards of the Spanish SMEs between 1998 and 2003 to less risky strategies implemented by gender-diverse boards. The stereotype threat theory suggests that female directors are unable to influence strategic board involvement through the contribution to board decision-making, as they are perceived as unequal board members and seen as only the token female director on boards (Nielsen & Huse, 2010a) .

In addition to the board of directors, the top management team of a company also plays an essential role in determining the performance of the company. Darmani (2013) investigates the performance of Indonesian companies and finds a negative association between female executive in the top management and

company performance. They also suggest that it is tougher for females to join large companies boards while smaller family-controlled companies are more likely to appoint female directors on boards. It is important to note that this study examines a cross-sectional data from the sample of Indonesia public listed companies in 2007 using simple regression analysis without considering endogeneity concern. Furthermore, public listed companies in Indonesia follow the two-tier governance system and the representation of female directors on boards in 2007 is relatively low. It is questionable that the estimation can be a reliable inference to investigate the relationship between female representation on the top management and company performance.

2.3.3 Studies That Show No Correlations Between Gender-Diverse Boards And Performance

The other stream of empirical studies shows no correlations between board gender diversity and company performance. These studies find that company financial performance is unrelated to the diversity of boards. Carter et al. (2010), using the sample of S&P 500 companies from 1998 to 2002, do not find any correlation between gender-diverse boards and performance. They attribute the non-significance of gender-diverse boards on performance to the contingency explanation because the effect of gender diversity on boards is offset over several companies under different circumstances and time periods. Dezsö and Ross (2012) based on the US sample of S&P 500 companies over fifteen years of panel data suggest that female representation in top management improves company financial performance only if the company strategy is focused on innovation. They hypothesise that the managerial attribute of female managers in the top management is an important moderator on company performance because female representation in top management improves the innovation intensity of company's strategy. However, the findings also indicate that merely examine the females participation in top management when the company's strategy is not related to innovation, gender-diverse in top management do not show a significant effect on company performance. The results support human capital and gender difference theory, suggest that when females join a company's top management team, it

adds insight into important strategic questions that are related to diverse consumers and stakeholders (Daily, Certo, & Dalton, 1999) .

Another study that explores the critical mass theory is Broome, Conley and Krawiec (2011). The outcomes of interviews with corporate directors and relevant insiders fail to support the critical mass of female directors on boards will produce different and distinct boardroom outcomes. In contrast with most of the studies that support boardroom critical mass of female directors (Arena et al., 2015; Konrald et al., 2008; Liu et al., 2014; Torchia et al., 2011), the respondents of this study reveal that they view themselves as path breakers. Female directors on boards do not behave as the general population; they are highly qualified corporate directors that need no reassurance or support from other female directors. They function as effective directors that are accustomed to their “outsider” status. The findings of this study also reveal the disadvantages of group effectiveness theory, where the respondents of this study indicate that as the proportion of female directors rises, group conflict arises and the disagreement with each other also increases due to the diverse viewpoints among the female directors.

Rose (2007) examines Danish public listed companies from 1998 to 2001 and also suggests that board gender diversity does not affect company performance. They imply that in order to be qualified for a board position, the unconventional directors choose to socialise and adapt to the behaviour and norms of the conventional directors and leaders. As the consequence of this socialisation process, the gains from having female directors on boards have never been reflected in any chosen performance measure. Marinova et al. (2016) also indicates that board gender diversity in Danish and Dutch public listed companies is rather low and this is the main reason for the insignificant correlation between gender-diverse boards and performance. Joecks et al. (2013) support the finding of low female board participation and argue that the insignificant results of gender-diverse boards on performance is affected by the overall low female board representation that invalidates the results. The possible reason for the insignificant effect of female board representation on company financial performance could be

related to the lack of significant impact, as female board representation has not achieved the critical mass that makes a real difference on company performance.

An event study by Farrell and Hersch (2005) find that there is no significant change in company market value with the appointment of females on boards of Fortune 500 companies from 1990 to 1999. This study suggests two reasons for the appointment of directors on a corporate board; to replace a departure of a director or to increase the board size. The findings of this study suggest that when board gender diversity is the goal of a company, it is very likely that the company will add female directors when the female is under-represented on the boards or to replace a departure director. The appointment of directors on boards is not gender neutral as the increment of female directors is not because of the increased supply of qualified female directors; rather it is the external pressure that force companies to add female directors. The study fails to detect significant market reaction to the appointment of female directors and gender-diverse boards do not generate better company performance. This indicates that the increment of female board representation due to internal preference or external pressure has resulted in the female candidates to self-select better performing company.

In the Australian context, Wang and Clift (2009) study the top 500 listed companies in Australia and suggest that although gender-diverse boards do not lead to poor performance, there is an absence of statistical significance between board gender diversity and performance. They argue that the absence of a significant impact of female directors on performance can be attributed to low females board representation, where female directors have not achieved the critical mass on boards to realise their potential and talents. Chappel and Humphrey (2014) also examine the sample of ASX300 companies listed on the ASX from 2004 to 2011. The findings suggest a weak negative correlation between gender-diverse boards and overall market performance. However, there is no clear performance differential between companies with and without female directors. This study uses the portfolio approach to examine the market-level impact on board gender diversity and suggests that larger and more established

companies have more diverse boards as a business proposition instead of for economic reasons.

Board gender diversity also affects company risk. The economic and psychological studies suggest that females have less risk appetite than males in general (Barber & Odean, 2001; Bernasek & Shwiff, 2001; Byrnes et al., 1999) . However, it is unclear whether the greater female board representation will lead to less risk-taking in board strategic decisions (Sila et al., 2016) . Sila et al. (2016) find no evidence that boards with greater female participation influence company's equity risk on the U.S. non-financial companies. This study extensively applies various GMM specifications to address the endogeneity concern in board composition studies. In contrast to the findings of less risk-averse of gender diverse boards of financial companies and females are have less risk appetite of the general population, this study finds that boards with higher proportion of female directors is no more or less risk-taking than boards that are dominated by male directors. The findings suggest that the negative relationships between board gender diversity and company equity risk are spurious and driven by unobserved between-firm heterogeneous factors.

2.4 Summary From Theoretical Framework And Empirical Studies

The theoretical frameworks provide various insights on the implications of gender-diverse boards on company performance. No single theory can completely explain and support the complex relationship. Different theories support the relevancy of gender-diverse boards and their implications on company performance in different ways (Carter, D'Souza, Simkins, & Simpson, 2010). The review of the literature also suggests conflicting findings from previous empirical studies. These differences arise from a number of factors including samples from different jurisdictions with different corporate governance practices and regulatory requirements. Further there is the vast spectrum of diverse model specifications with the application of various econometric techniques applied over different time frames. Both theoretical frameworks and prior empirical studies are unable to demonstrate a consensus on the relationship between board gender diversity and

performance. Larcker and Rusticus (2010) note that the development of a comprehensive theory is an ongoing process and may never be completed. On the other hand, to empirically examine the relationship between board gender diversity and company financial performance also face with technical challenges due to endogeneity issue.

The main issue in board gender diversity and company performance studies is the endogeneity concern, derives from the possibility of reverse causality concerns or the possibility of an omitted unobserved heterogeneity in the structural model that affects the relationship between board gender diversity and company performance. Farrell and Hersch (2005) confirm that neither board gender diversity nor the proportion of female directors is an exogenous random variable to company performance. WIntoki et al. (2012) and Schultz and Tan (2010) also demonstrate that the reverse causality between board characteristics and company financial performance are dynamic, meaning that current board gender diversity measure is likely to be the results of past realisation of company performance. In this instance, board gender diversity and performance are endogenously determined (Carter et al., 2003; Farrell & Hersch, 2005; Martin-Ugedo & Minguez-Vera, 2014) . There is a general consensus that board characteristics, and more particularly board gender diversity in this study, are affected by the scope of complexity of a company. It is also a choice that the company makes to determine the board structure and composition that suits its needs and nature of the business model (Coles, Daniel, & Naveen, 2008; Fama, 1980; Sila et al., 2016) . This requires us to take into consideration the most damaging endogeneity problem arises from reverse causality, company-level heterogeneity and omitted unobserved factors to examine and explain the implications of board gender diversity on company performance. Therefore, this study posits that the inconsistent findings of the extant literature are due to inadequate attempt in addressing the endogeneity concern using the appropriate econometric technique.

2.5 Hypothesis Development

This sub-section presents the hypothesis development based on the discussion of the theoretical framework and the literature reviews. The two hypotheses of this study are as follows:

2.5.1 Hypothesis 1 – Gender Diversity And Company Financial Performance

Agency theory, resource dependency theory, human capital theory and group effectiveness theory suggest that there is a theoretical valid link between gender-diverse boards and company performance. However, each theory suggests the relevancy of gender-diverse boards and company financial performance from a different theoretical perspective and each on their own is insufficient to explain the causal relationship between gender-diverse boards and performance. Moreover, the empirical studies show mixed results. The effect of gender-diverse boards on company financial performance is somewhat ambiguous with the continual development of theoretical frameworks and the inconclusive findings of prior studies. There is no clear indication of how female representation on boards will benefit the board functions and ultimately company performance. Hence, the first hypothesis of this study is:

H1: Ceteris paribus, board gender diversity is not correlated with company financial performance.

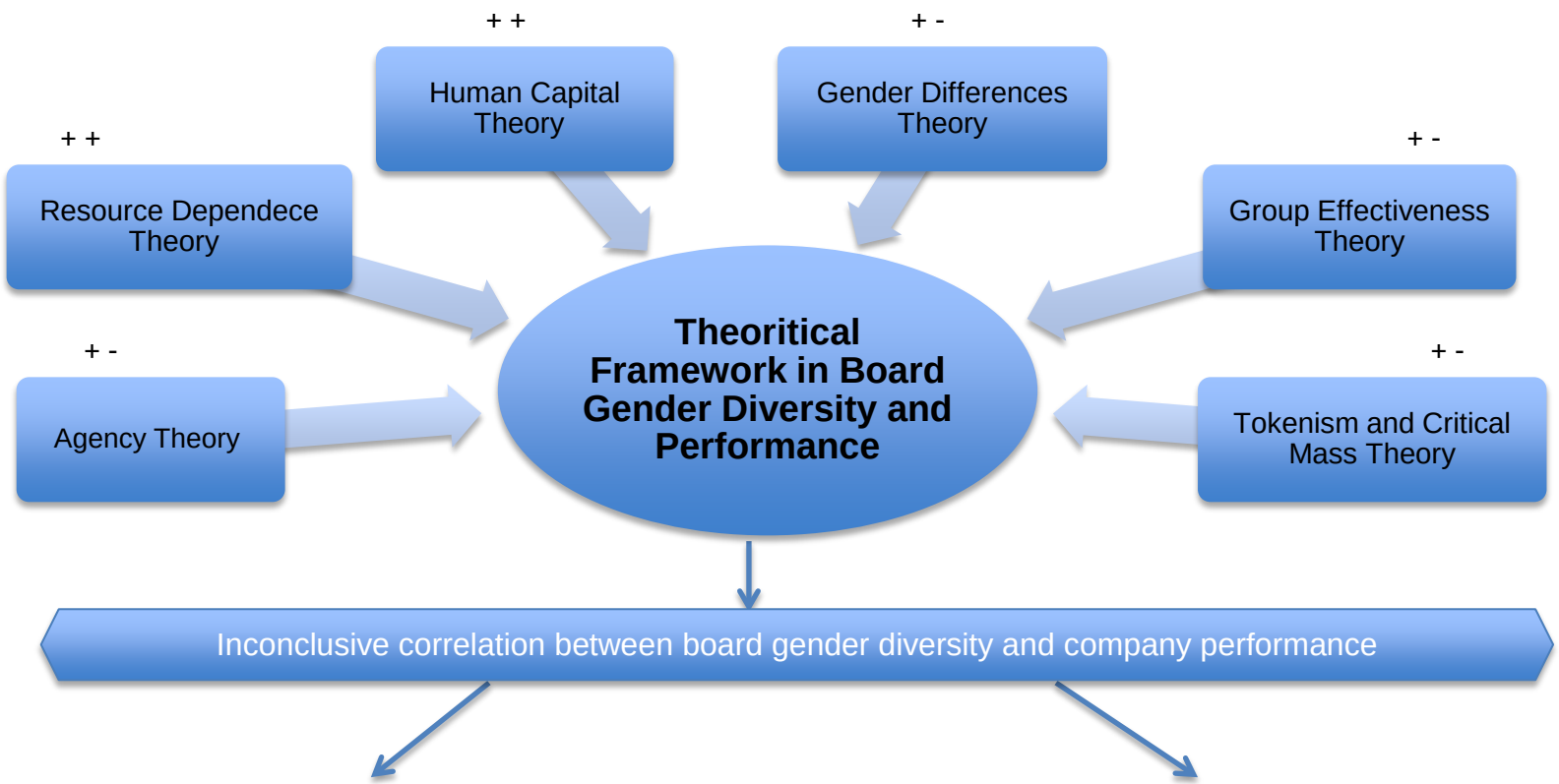
2.5.2 Hypothesis 2 – Critical Mass Of Female Board Representation

To identify if the critical mass of female directors on boards is a valid explanation for the impact of gender diversity on company performance, this study argues that there is a critical mass or optimal proportion of female board representation. This critical mass is essential in making the difference to the company performance. Kanter's critical mass theory raised the idea of "tokenism" of the female director on boards, referring to the sole female representation on a dominant male board. The sole female director may be treated as a token on the board, and her influence on the board decision may be limited. Erkut et al. (2008) suggest that the magic number of females on boards to have real performance impacts is three. This indicates that while the token female director may not have pronounced effect on board decision

processes and company performance, the critical mass of female board representation may have positive implications. Female directors are able to contribute and influence board decision making once female board representation achieves its critical mass. This study applies critical mass theory introduced by Kanter's study of men and women of the corporation (Kanter, 1977a) to examine the true impact of female board representation on performance. We hypothesise that female directors have a positive influence on company financial performance once a critical mass of board representation is achieved. This theory leads to the second hypothesis as:

H2: Female representation on boards has positive impacts on company financial performance when a critical mass is achieved.

Figure 2.1: Conceptual Framework on Board Gender Diversity and Company Financial Performance



Hypothesis 1: Ceteris paribus, board gender diversity is not correlated with company financial performance

Hypothesis 2: Female representation on boards has positive impacts on company financial performance when a critical mass is achieved

2.6 Chapter Summary

Figure 2.1 presents the conceptual framework of this study. The theoretical constructs do not provide a consensus on the relationship between board gender diversity and company performance. The discussion in the theoretical framework reveals that no single theory can predict the relationship between board gender diversity and performance (Carter et al., 2010). The link between board gender diversity and company financial performance is unclear. It depends on the individual company's governance structure, the directors' individual traits, the dynamic relationship among the directors of the company, the external environment, and the industry. Board gender diversity is affected by the scope of complexity of the company and is a choice that the companies make (Coles et al., 2008; Fama, 1980; Sila et al., 2016) . Previous studies also provide conflicting results due to differences in research contexts, model specification throughout a spectrum of time frame and application of various econometric techniques (T. Nguyen et al., 2015). This leads to the formation of both hypotheses of this study to examine whether there is a link between board gender diversity and company financial performance and if the critical mass of female directors on board influences company performance. The following chapter continues the discussion of the inconclusive findings in board gender diversity and company financial performance due to endogeneity problems and presents the methodological background of each econometric method in dealing with the endogeneity concern in gender diversity and company financial performance studies.

Chapter 3: Methodology

3.1 Introduction

Three key endogeneity issues that are endemic in board gender diversity and company financial performance studies are unobserved heterogeneity, simultaneous causality and dynamic relationship between the variables (Wintoki et al., 2012). These endogeneity concerns have always been the problem and undermine the causal inference of the variable. The design of a study must clearly identify the relationship of the variables and how each variable affects one another (Rusticus & Larcker, 2007). If a design of a study ignores the endogeneity problems, it limits the validity of empirical testing of the model, especially when the relationships of the variables are complex (Gippel et al., 2015). This study employs various econometric techniques to demonstrate why board gender diversity is not exogenous to company financial performance in the estimations, and present how the robust GMM method together with the selected noble instrumental variable mitigate all forms of endogeneity concerns.

This chapter presents the methodological framework, models and empirical measures used in testing the relationships between board gender diversity and company performance. It begins with a discussion of the challenging endogeneity issues that arise when examining board gender diversity and company performance. Specifically why board characteristics and females board representation are not exogenous to the company's performance The following sections present the data collection and sample selection process, the description of variables and the general model specification. Following is the methodologies used in previous board gender studies are reviewed and critiqued. The penultimate section describes the empirical indicators used and details the econometric techniques used in the analysis. The final section summarises the chapter.

3.2 Endogeneity Problem In Corporate Governance And Gender Diversity Studies

Studies examining the relationship between corporate board characteristics and performance are plagued with endogeneity issues (Wintoki et al., 2012). The endogenous nature of the corporate governance measures and company financial performance limits our understanding of the direction of causality between the two variables. If there is an omitted variable in a structural model, then causality cannot be inferred because only partial correlation can be observed, not causality. In this instance, it is difficult to establish whether board characteristics affect a company's performance, or if better-performed companies attract certain board characteristics. Specifically as board gender diversity is one of the board characteristics, similar endogeneity problems exist when a study examines the relationship between board gender diversity and company performance. The three main endogeneity concerns in the governance and diversity-performance literature are unobserved company-level heterogeneity, simultaneous causality bias and dynamic endogeneity between the variables in the model specification (Wintoki et al., 2012). Any study that does not address these endogeneity problems may be biased and raises a question of the internal validity of the model.

The first concern of endogeneity is whether unobserved company-level characteristics that may affect company's board structure and the performance. This issue arises when there is an unobserved factor that affects the relationship between the variables in a structural model. For example, an unobserved firm characteristic in gender diversity studies is companies' policy to improve their ethical corporate governance social image and appoint more female directors (Bear et al., 2010; Reguera-Alvarado et al., 2017). Stakeholder theory (Freeman, 2010) suggests that maintaining a good relationship with stakeholders increases company's legitimacy and social image, and consequently improves overall performance. Albuquerque, Durnev and Koskinen (2012) also suggest that the profitability of socially responsible companies is less sensitive to economic conditions and customers show greater loyalty towards the companies. There is a positive association between gender-diverse boards and these socially

responsible companies, and prior studies also show that socially responsible companies also exhibit better performance (Eagly et al., 2003; Labelle et al., 2010; Nadeem et al., 2017). In this instance, the company's practice that affects the appointment of female directors on boards is unobservable. Many previous studies also suggest that shareholders value a diversity perspectives and knowledge from board members and the appointment of female directors may improve companies share value (Gordini & Rancati, 2017; Kang et al., 2010) . In addition, self-selection bias can be classified as omitted variable bias (Heckman, 2013), which is unobservable in the specification. Companies may choose to have gender-diverse boards in the hope that will improve board monitoring, and consequently better performance (Adams & Ferreira, 2009; Gul et al., 2011) . We argue that a correlation between board gender diversity and company financial performance cannot be determined when there is a possibility of unobserved variable that exists and affects the company financial performance.

Secondly, there is an endogeneity issue caused by the simultaneous causality between the dependent and explanatory variables. In diversity-performance studies, there is a concern of a co-existence relationship between gender diversity and company performance. It is a challenging task to exogenously determine the dependent variables and to address the possibility of reverse causality relationship. Several studies show that company size and performance affect the appointment of gender-diverse boards (Charles et al., 2015). Also, a company may also choose the board structure that suits its operation and industry's norm (Adams & Ferreira, 2007) . Conversely, female directors may be more attracted to join better-performed companies with greater corporate social responsibility (Hafsi & Turgut, 2013; Nadeem et al., 2017; Turban & Greening, 1997) . This is an example of cause and effect relationship with feedback loops between gender-diverse boards and performance. This self-selection bias causes an unclear casual relationship between gender diversity and company performance. The simultaneous causality between the proportion of female directors and company financial performance confound the relationship between the variables. It is essential for empirical studies to address the possibility of biased and inconsistent

parameter estimates caused by the simultaneity issue to make a reliable inference of the relationship between gender diversity and performance.

Finally, endogeneity is influenced by the dynamic relationship between a company's past performance and their current board structure and current performance. For example, although Tobin's Q is a good proxy for company financial performance as it measures the future growth of a company, the change in Tobin's Q over time can be affected by the market's valuation of future growth. A company's future growth prediction may influence the board structure to suit the economic and industry conditions (Pham et al., 2011) . In this instance, there is a dynamic relationship between the past performance on the current performance and the board structure. Furthermore, the relationship between board characteristics and performance are dynamic (Cicero, Wintoki, & Yang, 2013; Wintoki et al., 2012) . This means that past performance affects the appointment process of the board of directors and the representation of females on boards. In this instance, the existing board will take into consideration the previous performance indicator in appointment decision concerning the board structure. It is potentially impossible for empirical studies to capture all the dynamic determinants of company performance. To address this endogeneity problem caused by the dynamic relationship and possible omitted variable bias, relevant structural equation models are required to incorporate as many representatives and independent indicators as possible.

To address the endogeneity concerns in diversity-performance study, theoretical arguments alone are insufficient to explain the causality relationship between gender diversity and company performance. It requires careful research design and appropriation analysis (Antonakis, Bendahan, Jacquart, & Lalive, 2010) . Fornell & Larcker (1981) state that variables selection is crucial. A good understanding of variables interaction is crucial to identify the causality direction among the variables. Endogeneity issues commonly arise amongst past research design that are intended to determine causality relationship. This is particularly common in corporate governance research as the relationships among the

variables is complex (Rusticus & Larcker, 2007) and there are observed and unobserved factors that may influence the appointment process of the board of directors.

Given all three possible causes for endogeneity in a diversity-performance study, a researcher needs to develop a convincing theory that supports the research design and then apply appropriate statistical techniques to mitigate the endogeneity issue. Larcker and Rusticus (2010) suggest that developing a strong and convincing theory to support the relationships between the variables is important to explain the direction of the causality effect. However, theory development is an ongoing process and is often an incomplete explanation of the relationships.

Pindado and La Torre (2004) suggest that the solution to control an endogeneity problem is by way of applying the method of instrumental variables. Identifying an instrumental variable is a common empirical strategy to deal with endogeneity problem. It helps explain that gender diversity is exogenous to the performance outcomes in the estimate. Although this instrumental variable approach overcomes the issue of biases in OLS regressions (fixed or random effect estimation), finding a truly exogenous instrumental variable is not an easy task. Bozec (2012) confirms that the most challenging task for a researcher to address the endogeneity problem in a corporate governance study is to find a valid and exogenous instrumental variable. Larcker and Rusticus (2010) suggest that a good instrumental variable needs to be justified using economic theory. In addition to theoretical support for the instrumental variable, there are two econometric requirements; first, the instrumental variable is correlated with the endogenous explanatory variable; and second, the selected instrumental variable is uncorrelated with the error term in the structural equation or the dependent variable. The selection of a weak instrumental variable in gender diversity and company performance studies can be inefficient. Furthermore, if the relationship between the board characteristics and performance is dynamic, a weak instrumental variable may not be truly exogenous and may influence the

company's performance. In this instance, a study requires an empirical model that considers both the influence of unobserved heterogeneity and the dynamic relationship between the past performance of the board structure and current performance (Wintoki et al., 2012).

Given the challenging in identifying the exogenous external instrumental variable, prior studies suggest that the alternative and more convincing method to mitigate the endogeneity issue in diversity and performance study is by way of natural experiment. Gippel, Smith and Zhu (2015) suggest that research in accounting and finance should look beyond textbook solutions and design a natural experiment to mitigate the endogeneity issue. The natural experiment utilises the exogenous source of change in the problematic explanatory variable and testifies the effect of the variation in the dependent variable. For example, Ahern and Dittmar (2012) exploit a natural experiment with the implementation of new legislation to impose gender quotas on Norwegian corporate boards as an unprecedented exogenous shock to the existing board structure to examine the relationship between gender-diverse boards and company performance. Schmid and Urban (2017), based on an extensive database of 53 countries' company boards, consider the retirement of female directors due to death and illness as the exogenous shock to the system to examine the market reactions from the news. They report that the share market reacts negatively to the retirement of the female directors and the situation is more significant if the departure of the female directors is replaced with male directors.

It is important to note that the endogeneity issue needs to be addressed in all studies in addition to a well-developed theory. A good empirical design with high-quality data is crucial in empirical research. The research design will then fit into a selected statistical technique to test the hypotheses with an intention to mitigate the endogeneity issue. Clear empirical evidence can resolve the confounding effect of endogeneity and conflicting arguments that undermine the causal inference between the variables. Robert and Whited (2013) emphasise that

researchers should not be discouraged from carrying out a study even with the presence of the endogeneity issue.

3.3 Overview of Research Design

Section 2.6 presented the two hypotheses of this study. The first hypothesis examines if there is any relationships between board gender diversity and company financial performance. Given the inconclusive findings of previous literature and the ambiguous theoretical frameworks of the impact of gender-diverse boards on company performance, there is no clear indication of how female board representation on boards will impact company financial performance, hence the first hypothesis of this study is:

H1: Ceteris paribus, board gender diversity is not correlated with company financial performance.

The second hypothesis examines if the critical mass of female board representation have positive implications on company performance. This study applies Kanter's (1977b) critical mass theory to examine the true impact of female board representation on company performance. We hypothesise that female directors have a positive influence on company financial performance once a critical mass of board representation is achieved. This theory leads to the second hypothesis as:

H2: Female representation on boards has positive impacts on company financial performance when a critical mass is achieved.

These two hypotheses are tested using the general model as shown in equation (1) to regress the board gender diversity and other control variables on company financial performance as follows:

$$P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \varepsilon_{it} \qquad t = 1.\ldots\ldots t,\ i = 1.\ldots\ldots n \quad \text{---------- (1)}$$

Where:

- P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations
- GD – The n*1 matrix of gender diversity measure across N observations
- CV – The n*k matrix of the control variables across n observations
- β – The unknown k*1 vector of regression parameters
- ε – A n*1 vector of the error term
- i – The number of n observations of the sample
- t – The time period of each financial year
- k – The number of control variables used in the structural model

In this study, Tobin's Q is the focus of company financial performance indicator. Tobin's Q measures companies' market value and reflects market's expectation of the companies' future growth (Montgomery & Wernerfelt, 1988) . Board gender diversity measure is represented by the proportion of female directors on boards as the primary focus and the Blau index as the robustness test on gender diversity analysis to examine the first hypothesis. This study also applies Kanter's critical mass gender classification as the gender diversity measure to examine the second hypothesis. The board characteristic control variables are board size, board independence, CEO tenure and CEO duality. At the company level, this study controls for company size measured in market capitalisation and total revenue, company's leverage levels measured by net gearing ratio, and risk level measured by volatility of return on equity (ROE). The following section will discuss the data collection procedures and the variables in the model specification in details.

3.4 Data Collection Procedures

The sample for this study consists of Australian top two hundred companies listed on the Australian Stock Exchange (ASX) for the period from 2008 to 2015. Table 3.1 presents the summary data collection procedures.

Table 3.1: Data collection procedures

Procedures	Specific details of data collection procedures
Step 1	Sample selection process – identify the companies in ASX200 as at 31st December 2015
Step 2	Financial data – download financial report from MorningStar DatAnalysis premium database
Step 3	Board characteristics – download directors and board structure information from SIRCA's corporate governance portal
Step 4	External instrumental variable – identify each of the selected sample's headquarters' address and match to the respective local council, extract the councillor's information from the identified local council's annual report
Step 5	Cross check of financial data and board characteristics information with Bloomberg database
Step 6	Statistical analysis – apply Stata 14 to test the hypotheses

The details of these processes are explained in the following section.

3.4.1 Sample Selection and Test Period

The initial sample of this study consists of an unbalanced panel data of the top 200 public listed companies (ASX200) on the Australian Stock Exchange (ASX) for the period from 2008 to 2015. The ASX200 index is accounted for about 70% of Australian's market capitalisation. There are three listing and qualifying conditions for companies to be listed in the ASX200 index[16]. These three conditions are:

i. The stock must be listed on the ASX as ordinary or preferred shares;
ii. The stock must satisfy liquidity requirements, that is the stock must be actively traded on the ASX and investors can easily buy and sell the stock on the market; and
iii. The stock's market-adjusted capitalisation must be amongst the largest 200 companies on the ASX.

The ASX200 index is rebalanced quarterly, indicating that some companies can be added or removed from the index during the study period of this study. Hence, this study includes all companies that have been classified in the ASX200 listing in any of the quarters from 2008 to 2015 to mitigate the possibility of survivor bias. The entire sample in the dataset consists of 319 companies. The sample companies' market capitalisation ranges from $2.2 million to $244 billion. This indicates that the sample of this study covers a wide range of companies in terms of size measured in market capitalisation.

Following previous literature (Adams & Ferreira, 2009; Kiel & Nicholson, 2003) , this study excludes companies that are classified as banks and insurance with GICS industry grouping due to their unique reporting and regulatory requirements. This study also excludes firm-years when a company is being delisted from the ASX as the financial information is no longer available, results in missing values, which cannot be obtained from any other sources.

[16] Qualifying in the ASX 200 index listing. Refer https://www.wise-owl.com/investment-education/asx-200-explained-what-is-the-asx-200 and https://www.marketindex.com.au/methodology and https://www.asx200list.com/

The final sample of unbalance data consists of 299 companies for the period from 2008 to 2015 with 1981 firm-years. Table 3.2 summarises the sample selection and table 3.3 presents the summary of the sample by year.

Table 3.2: Sample selection

Initial sample size:	319 companies listed on the ASX200 from 2008 to 2015
Minus:	15 companies classified as banks and insurance with GICS code
Minus:	5 companies with insufficient financial data
Final sample size:	299 ASX200 companies listed on the ASX from 2008 to 2015

Table 3.3: Summary of the sample by year

Year	No of companies
2008	265
2009	261
2010	261
2011	254
2012	240
2013	236
2014	236
2015	228
Total Firm Year	1,981 firm-years

3.4.2 Collection Of The Financial Data

Once the finalised sample is selected, the financial data of each company are obtained from the MorningStar DatAnalysis Premium database. Each companies' registered headquarter address is used for identifying the local government of the respective companies to match the locality of the selected external instrument variable of this study, the proportion of local female councillors. We use GICS codes to identify the industries in our sample. Appendix 9 shows the definition of the selected financial variables of this study.

3.4.3 Collection Of Board Characteristics And Directors Information

Board characteristic and directors' data are downloaded from the SIRCA Corporate Governance portal. This database provides detail information of companies' board characteristics and directors, which includes name, gender, birth year, date of appointment and resignation to the company, education attainment and qualification, position held in the company and other directorships if any. The entire director's database is downloaded, and the relevant information is sorted according to the specification of this study. Appendix 10 shows the definition of the board characteristics and directors' variables extracted from this database.

3.4.4 Cross Check Of Financial And Board Of Directors Data

Once the financial data and board characteristic information are collected, a data integrity check was carried out. Any ambiguous and missing information are cross-checked against the company's annual reports and Bloomberg database.

3.4.5 Selection And Data Collection Of Instrumental Variable

Section 3.2 demonstrates the damaging effects of endogeneity issues if it is not being addressed in a study. This study applies an external instrumental variable method to address the endogeneity problems and robust testing of the relationship between board gender diversity and company financial performance. Larker and Rusticus (2010) specify that the selection and usage of an instrumental variable need to be justified using economic rationale and Roberts and Whited (2012) postulate that the influence of the instrumental variable on the estimations should only through its effect on the endogenous variable. A valid instrumental variable needs to fulfil two fundamental requirements, the exogeneity and the relevancy of the instrumental variable. A non-correlation between the instrumental variable and the error term indicating that the instrumental variable is exogenous to the error term. On the other hand, the instrumental variable needs to be correlated to the exogenous variable to be relevant. Section 3.6.3.2 will demonstrate the statistical

technique to test if this instrumental variable fulfils the two fundamental requirements in applying instrumental variable.

This study follows Gippel et al.'s (2015) suggestion and uses the proportion of local female councillors as the instrumental variable for female board representation. This instrumental variable has not been tested and applied in board gender diversity. The selection of this external instrumental variable also supported by two studies. First, we refer to Terjesen et al.'s (2015) "influence of political science in corporate governance". Their study signpost that the elite government who endorse gendered policies supports the improvement of female board representation. This suggestion is based on the premise that institutional establishment co-evolves with corporate gender policies. Second, Bouwman's (2012) theory of "economic ramification of distance". In this study, Bouwman demonstrates how CEO's compensation is affected by the envy factor and the influence of locality "leading-company". He postulates that geography factor has led the companies in a given area follow the "leading-company" in the same geography coverage in setting CEO compensation. In addition, using the same argument of geography influence, Bouwman (2012) also uses the professional sports players' compensation as the instrumental variable to the CEO's compensation in the same area to address the endogeneity in the study. King and William (2013) follow Bouwman's application of instrumental variable and use local sports person's salary to instrument with the bank's executive compensation. Using both the locality influence and the role of government, this study believes that local female councillors play an important role in influencing other females' involvement in the workforce and have a positive impact on the experienced and skilled females to excel as directors on corporate boards. Therefore, the proportion of local female councillors is instrumented to the proportion of female directors on boards to address the endogeneity concerns in this study.

The external instrumental variable in this study, the proportion of local female councillors, is hand collected and extracted from the annual report of each local council website. To collect the local councillor's information, we link each

companies' headquarter office of our sample to its respective local governments and extract the local council members' information from the local government annual report of the respective year of observation. If the annual report is not available on the website, we send an email to the local council representative requesting current and past councillors' information.

3.4.5.1 An Additional Note On Instrumental Variable

Finding a truly valid instrumental variable is a challenging task. The researchers can use their imagination and creativity in selecting the instrumental variable. Larcker and Rusticus (2010) signify that it is important to use economic theory to identify a valid and exogenous instrumental variable. However, it is challenging to use economical meaningful external instrumental variable compared to using a lagged variable in the model specification (Gipple et al., 2015). Gipple et al. (2015) also suggest that it is essential to run Hausman-Wu endogeneity test, relevancy F-test between the endogenous variable and the instrumental variable, and Hansen's over-identifying Chi-square test to validate the instrumental variable. As it is difficult to find a truly exogenous instrumental variable in addressing the endogeneity issues, the common approach for board gender diversity studies in applying instrumental variable method is by way of using lagged value of the endogenous variable (Campbell & Mínguez-Vera, 2008; Carter et al., 2010; Gordini & Rancati, 2017) . This is questionable as the lagged value of the endogenous variable can be correlated to the dependent variable. In board gender diversity and company financial performance study, it is very likely that the lagged value of female board representation affects company performance. In this instance, the lagged value of the endogenous variable will not fulfil the exogenous requirement.

Table 3.4: Some examples of external instrumental variable used in board gender diversity studies

Authors	Focus of study	Instrumental variable
Adams and Ferreira (2009)	Board gender diversity on performance in the U.S.	The proportion of male directors who sit in other boards with the presence of female directors
Capezio and Mavisakalyan (2016)	Female directors and fraud in Australia	The CEO's first name femininity as a proxy for gender awareness
Hsu, Kuo and Chang (2016)	Gender diversity in accounting company's partnership and performance in Taiwan	The number of female employee of the company
Jurkus, Park and Woodard (2011)	Female at top management and agency cost in the U.S.	The proportion of increment in female resident population in the state of the company
Liu, Wei and Xie (2014)	Board gender diversity on performance in the China	The proportion of female directors and the proportion of female employment in the company's industry
Marinova, Plantenga and Remery (2016)	Board gender diversity and company financial performance in Netherlands	The proportion of female in the company's industry
Smith, Smith and Verner (2006)	Female at top management and company financial performancein Denmark	The average length of education of the company's CEO's spouse

Table 3.4 presents some examples of the external instrumental variable used in board gender diversity studies. Among the list of the instrumental variables, the exceptional external instrumental variable is the proportion of male directors who sit on other boards with the presence of female directors used in Adams and Ferreira (2009) study. This instrumental variable is also commonly followed by other studies (Adams & Ragunathan, 2017; Gregory-Smith, Main, & O'Reilly, 2013; Levi, Li, & Zhang, 2014) . The economic argument on using this instrumental variable is that females have less access in professional network compared to male counterparts. Therefore they instrument that the proportion of male directors with a connection to the external female directors to the fraction of female directors on boards. It is debatable if this instrumental variable fulfils the exogeneity test. If there is a professional network between male directors and

female directors on other boards, could there be a strategic tie or business relationship between the companies and exchange of some information? If this were the case, would the relationships between directors have any implications on the company performance? Sila et al. (2016) tested this instrumental variable in their study in relation to board gender diversity on company risk. The statistical tests of their study substantiates that this instrumental variable is not valid in their estimation. Due to the limited information in the dataset, this study does not replicate this instrumental variable and unable to substantiate the relevancy and the exogeneity of this instrumental variable.

3.5 The Variables

This section describes the dependent, independent and control variables used in this study. This study adopts the variables selection used in previous research that examines the relationship between gender-diverse boards and company financial performance in the selection of the variables. Table 3.5 presents the summary definition and formula of each variable of this study. Each of these variables is then discussed in detail in the sub-section that follows.

Table 3.5: Summary of the variables

Dependent Variables (Company financial performance)	
Tobin's Q	$\mathrm{Q} = \frac{\text{Market Value of Equity} + \text{Book Value of Debt}}{\text{Book Value of Assets}}$
Variable of Interest: Gender Diversity Measures	
Proportion of female directors	$\mathrm{PFOB} = \frac{\text{Total number of female directors on boards}}{\text{Board Size}}$
Blau Index	$\mathrm{B} = \sum_{c=1}^{k} 1 - [S^2 + (1 - S^2)]$ Where: k – the number of categories (k=2 for gender study, that is male and female) S – the proportion of female directors
Critical Mas classification based on Kanter's grouping of gender diversity measure	K1 (Uniform group) - Dummy variable equals to 1 when a board has no female directors and 0 otherwise; K2 (Skewed group) - Dummy variable equals to 1 when the proportion of female directors is more than 0% but less than 20%, and 0 otherwise; K3 (Tilted group) - Dummy variable equals to 1 when the proportion of female directors is equals or more than 20% but less than 40%, and 0 otherwise; K4 (Balanced group) - Dummy variable equals to 1 when the proportion of female directors is equals or more than 40%, and 0 otherwise.
Critical Mas classification based on amended / incremental female board representation classification	ACM0 – Dummy variable equals 1 to 1 when a board has no female directors and 0 otherwise; ACM20 – Dummy variable equals to 1 when there is at least 20% female directors on boards and 0 otherwise; ACM30 – Dummy variable equals to 1 when there is at least 30% female directors on boards and 0 otherwise; ACM40 – Dummy variable equals to 1 when there is at least 40% female directors on boards and 0 otherwise;
Control Variables (CV) **a) Board Characteristics Variables**	
Board Size	Board = Total number of directors on boards
Proportion of Independent directors	$\mathrm{PIndDir} = \frac{\text{Total number of independent directors on boards}}{\text{Board Size}}$
CEO Tenure	CEOT = Total number of years CEO sitting on boards
CEO Duality	CEODua = Dummy Variable equals 1 if CEO is also the Chairman of the board or 0 otherwise
b) Company Level Variables (CV)	
Company size	LogMC = Log of total market capitalisation, measured by total number of share outstanding x share price as at the financial date
Sales revenue	LogRev = Log of total sales revenue
Net gearing	NDE = (Short term debt + long term debt - cash) / shareholders equity
Volatility of ROE	VROE = Standard deviation of annual ROE over the last 3 years

3.5.1 Dependent Variables – Company Financial Performance

Various empirical indicators are used to measure company financial performance in the literature (Mackey, Mackey, & Barney, 2007) . This study defines the market-based measure of company performance, Tobin's Q, as the dependent variable of this study. The choice of Tobin's Q as the performance measure is consistent with previous literature (Adams & Ferreira, 2009; Campbell & Mínguez-Vera, 2008; Dezsö & Ross, 2012) . Tobin's Q was introduced by James Tobin in 1978 and has been used to measure company financial performance in Western and developed countries with more stable and strong capital market structure, such as the United States and European countries. Similarly, the Australian capital market is comparatively stable and follows a similar market trend to the United States and Europe, allowing Tobin's Q to be a useful market-based performance measure to examine company financial performance of the Australian companies.

Most literature (Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Campbell & Minguez Vera, 2010; Carter et al., 2010; Conyon & He, 2017; Schultz et al., 2010) use Chung and Pruitt's (1994) approximation of Tobin's Q as the measurement of company financial performance. This is calculated as the sum of the market value of company's common stock plus liquidating value of preferred stock plus book value of debt divided by book value of total assets. This study applies this approximation and calculates Tobin's Q as followed:

$$\text{Tobin's Q} = \frac{(\text{Market Value of Equity} + \text{Book Value of Debt})}{\text{Book Value of Assets}}$$

Where:

Market value of equity	= Market share capitalization = Total number of shares issued * share price (as at the end of the company's financial year)
Book value of debt	= Total liabilities
Book value of assets	= Total assets

The ratio of Tobin's Q provides a yardstick for measurement of company financial performance. Investors expect that the company can create positive returns with effective use of currently available resources if the Q ratio is more than one. It represents the company's strong competitive advantage with growth opportunity (Campbell & Mínguez-Vera, 2008; Gordini & Rancati, 2017; Rose, 2007) . Poor utilization of resources is indicated by a Q ratio of less than one, meaning that the company is unable to create more value with existing resources. As Tobin's Q is a market-based measurement and embodies the market expectation of company financial performance, it enables the market to forecast the future cash flow and provide an assessment of the company's investment opportunities.

The rational to use Tobin's Q over other common accounting measure is because it measures market performance of wealth of a company that emphasises future expected earnings capacity of the company. While most of the accounting measures (e.g. ROA and ROE) measure past performance, it does not capture the future potential growth and earnings of a company (Demsetz & Villalonga, 2001) . Hence, Tobin's Q is a suitable proxy for a company's competitive advantage as it measures a companies' market value and reflects the market's expectations of future earnings (Montgomery & Wernerfelt, 1988) . The market value of a company is also determined by distributed shareholders' return and consequently driving the share price and market capitalisation of a company. Furthermore, the value of Tobin's Q is associated with intellectual capital, where companies with high Tobin's Q is expected to improve the financial performance through the greater use of companies' higher intellectual capital (Coles et al., 2008; López & Morrós, 2014) . Tobin's Q focus on future performance has allowed it to gain acceptance in recent studies.

However, Tobin's Q has a few weaknesses as the performance measure of a company. As Tobin's Q uses book value of debt and book value of assets, it is subjective to the accounting treatment of liability and assets on the balance sheet. Moreover, as Tobin's Q indicates the growth opportunity of a company, any

changes over a company's Q over time may reflect changes to its growth opportunity in the future. This future growth may be driven by economic and the industry conditions. Zhuo (2001) indicates that the changes in company value may be a result of noise when examining the effects of governance characteristics on company's performance.

Tobin's Q is more forward-looking than the accounting measure of performance in which the value of companies reflects more on the company's current plan and strategies (Kiel & Nicholson, 2003) . The examples of the other alternative accounting measures of company financial performance are return on assets (ROA) and return on equity (ROE). This market-based performance measure is also more reflective of market responses to particular company's decision (Griffin & Mahon, 1997) . Kiel and Nicholson (2003) indicate that market-based measures of performance are more important compared to the accounting-based measure of performance in board composition studies in Australian public listed companies. The accounting-based measure can be subjective as management of the company can choose the adoption of accounting standard and policy depending on their circumstances and intention.

3.5.2 Variable of Interest – Board Gender Diversity Measures

The main focus of the explanatory variable in this study is board gender diversity. To examine the effect of gender-diverse boards on company performance, this study employs the proportion of female directors on boards as the primary measure of board gender diversity. We also include the Blau index as a robustness check on the effect of gender-diverse boards on company performance. To test the second hypothesis on effects of critical mass of female directors on boards, this study applies Kanter's critical mass theory and classifies the proportion of female directors on boards according to Kanter's classification groups as the measure of board gender diversity. The following section presents the details of the board gender diversity measures.

3.5.2.1 The Proportion Of Female Directors On Boards

Previous literature that employ the proportion of female directors on boards as the gender diversity measure are Adams and Ferreira (2009), Ahern and Dittmar (2012), Allemand and Barbe (2014), Campbell and Mínguez-Vera (2010), Darmani (2013), and Erhardt et al. (2008). It is measured by dividing the number of female directors on the board with the total number of board members of a company as followed:

$$\text{PFOB} = \frac{\text{Total number of females board representation}}{\text{Board size}}$$

Where:

PFOB – The proportion of female directors on board

Board Size – Total number of board members

The proportion of female directors provides a more meaningful board gender diversity measure than other gender diversity measures, such as the absolute number of female directors or the dummy variable that measures the presence of female directors on boards. This is because the proportion of female directors on boards takes into account the board size in relative terms.

3.5.2.2 Blau Index

This study also users another widely used diversity measure for categorical variables, the Blau index, as the robustness check on the relationship between board gender diversity and performance (Bear, Rahman, & Post, 2010). Blau (1977) measures the diversity using the following formula:

$$\text{B} = \sum_{c=1}^{k} 1 - [S^2 + (1 - S^2)]$$

Where:

k – the number of categories (k=2 for gender study, that is male and female)

S – the proportion of female directors

The Blau index measures the diversity of the sample by considering the ratio of female and male directors, using the proportion S as stated above. This study sample consists of two groups of diversity measures, the groups of male and female directors. In this instance, k equals two. A proportionate board with equal numbers of male and female directors will have a maximum Blau index value of 0.5, and boards with no diversity will have a minimum Blau index of zero (Miller & Triana, 2009) . Previous studies that employ the Blau index as the measure of board gender diversity are Ali, Kulik, and Metz (2011), Campbell and Minguez-Vera (2008), Joecks, Pull and Vetter (2013).

3.5.2.3 Kanter's Classification of Gender Diversity

To test the second hypothesis of this study, we apply the critical mass theory and measure the board gender diversity with Kanter's (1977b) four gender diversity categories. Consistent with Joecks, Pull and Vetter (2013), Liu, Wei and Xie (2014), Strydom, Au Yong and Rankin (2017), and Konrad, Kramer and Erkut (2008), we create four sets of dummy variables for each of the four gender diversity categories that reflect Kanter's critical mass grouping as:

i. Uniform group: K1 equals one when board consists of all male directors and zero otherwise;
ii. Skewed group: K2 equals one when there is at least one female director but less than twenty percent female directors on boards, and zero otherwise;
iii. Tilted group: K3 equals one when there is at least twenty percent but not more than forty percent of female directors on boards, and zero otherwise;
iv. Balanced group: K4 equals one when there are at least forty percent of female directors on boards, and zero otherwise.

This study also extends the critical mass theory and modifies the gender grouping in an incremental order. The rationale for this amended grouping is to allow

comparison of boards with less female board representation to boards with more female directors. Based on Kanter's original critical mass classification, we compare the dummy group to others that do not belong to the category. For example, the analysis of K2 category, which is the skewed group consisting of boards with at least one but less than twenty percent female directors are compared to K1 boards with all male directors and also boards with twenty percent or more female directors, which is K3 and K4 boards. The amended gender classification enables this study to examine the level at which female board representation affects company performance. The amended critical mass classifications of female directors on boards are as followed:

i. ACM0 – Dummy variable equals one when board has no female director and zero otherwise;
ii. ACM20 – Dummy variable equals one when there is at least twenty percent of female directors on boards and zero otherwise;
iii. ACM30 – Dummy variable equals one when there is at least thirty percent of female directors on boards and zero otherwise; and
iv. ACM40 – Dummy variable equals one when there is at least forty percent of female directors on boards and zero otherwise.

3.5.3 Control Variables

This study also includes control variables in our model to isolate the effects of female board representation on company performance. We rely on previous corporate board gender diversity studies to identify the relevant control variables that may have an impact on company performance. In general, previous studies categorise the control variables into two groups; the board characteristic control variables and company level control variables (Christensen et al., 2010; Kiel & Nicholson, 2003; Pham et al., 2011; Schultz et al., 2010) . This study applies the same concept, and the following sub-section presents both board level control variables and company level control variables.

3.5.3.1 Board Characteristic Control Variables

The board of directors defines the strategic direction and significant decisions that determine the success of a company. Hence, board characteristics influence the company performance, and the important board characteristics should be included as control variables when determining company performance. The board characteristic control variables in this study are: board size measured as the total number of board directors (Board), the proportion of independent directors (PIndDir), CEO's tenure (CEOT) and CEO and board's chairman duality dummy (CEODua).

Board size (Board) is an important trait that determines the effective monitoring and controlling of the management team and carries out the advising role to the CEO (Fama, 1980; Jensen & Meckling, 1976) . Prior literature that examines the relationships between board structure and company financial performance argue that there is a negative correlation between the board size and board effectiveness (Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Lückerath-Rovers, 2013) . These studies argue that when the board increases in size, there is a tendency to increase agency problems. Jensen (2010) suggests that there is a tendency of free riding and ineffective monitoring of the managerial function with large boards. A larger board generally lacks cohesiveness and it is difficult for the CEO to engage every board member in meaningful and interactive discussions. Jensen (2010) also suggests it is more difficult to coordination large boards. A large board tends to symbolise the success or power of a company rather than fulfilling its function in the management role and setting the strategic direction of the company (Hermalin & Weisbach, 2001) . Lipton and Lorsch (1992) recommend that the optimal number of directors on a board is seven or eight as any board larger than this size could result in ineffective discussion. On the other hand, some studies suggest an inverse relationship between board size and company financial performance (Bhagat & Black, 2002; Mak & Kusnadi, 2005; Yermack, 1996) . These studies argue that smaller boards create more value than larger boards as smaller boards interact better and are more effective in coordinating and

communicating with board members. This creates meaningful involvement and cohesiveness among the board members.

Board independence (PIndDir) is an important trait that reflects the monitoring capacity of the corporate board of the management team (Fama, 1980). It is conventional wisdom to accept that board independence adds value to the company as they oversee the executive and management teams in carrying out their duty. The advocates for good corporate governance suggest that the majority of the board members should comprise independent directors[17]. However, prior studies demonstrate mixed results on board independence and company performance. For example, Adams and Ferreira (2009) found a mixed result on the proportion of independent directors with company financial performance dependent on the estimation method used. They found a significant positive relationship with 2SLS estimation and significant negative relationship with a GMM model. Hermalin and Weisbach (2001) and Bhagat and Black (2002) found insignificant relationships between outside directors and company's financial performance. Chen and Tjosvold (2013) found a positive correlation between the proportion of independent directors and the quality of financial disclosure that leads to subsequent improvements in financial performance.

The CEO's roles in a company include the making of major corporate decisions, implementation of high-level operational strategies with the executive team of managers, and maintaining the communication with the board of directors. We use the proxy of CEO tenure to measure the CEO's experience in managing a company. We believe that the longer the CEO is responsible for managing the company, the CEO accumulates more executive experience in the company as well as the industry, and that leads to better performance, in terms of the company and the CEO's human capital. CEO tenure refers to the number of years the CEO is serving with the company. This study accounts only on the full years of service as a CEO and not partial years of service as the CEO tenure measures.

[17] ASX Corporate Governance Council's 2014 edition: Principle 2.4 of Corporate governance principles and recommendations.

The roles of the chairman of a company's board is to assure that there is active and adequate communication between the board of directors and the management team, responsible for planning and developing an effective board of directors and executive team to implement the company's overall strategies (Ammari et al., 2014). Jensen and Meckling (1976) suggest that the separation of management and control roles of CEO and Chairman could reduce the agency costs and possible abuse of power and consequently improve company performance. Other studies also suggest that the combination of the CEO and the Chairman's role is an obstacle to board's duties as it weakens the control mechanism of the board and there are no significant advantages of having combine role of the CEO and the Chairman (Carty & Weiss, 2012) . Hence, this study includes CEO duality (CEODua) as the control variables at board level as it affects the effectiveness of board monitoring (Bear et al., 2010) and performance in the broader aspect. The Australian corporate governance council also recommended that the chairman of the board should be independent director and CEO of the company should not be the chairperson of the board of directors[18]. The variable CEO duality (CEODua) refers to the dual function of the CEO, which is when an individual is holding a dual position as the Chairman and the Chief Executive Officer (CEO) of a company. It is a dummy variable equals to one when the same individual holds the role as the CEO and the Chairman of the board concurrently, zero otherwise.

3.5.3.2 Company Level Control Variables

In addition to the board level control variables, this study also controls for a number of company-level variables that affect performance. These variables are obtained from the financial reports, and they are company size, company's gearing, and risk level.

[18] ASX Corporate Governance Council's 2014 edition: Principle 2.5 of Corporate governance principles and recommendations.

Company size is widely used as a control variable in board gender diversity studies. In general, larger companies have the economies of scale that influence the industry and the market trend. Hence a positive correlation between company size and company financial performance is expected. A study by Lee (2009) suggests that larger companies tend to perform better than the smaller companies as larger companies have more growth potential and are more efficient with higher market power. Many different proxies are used to measure company size in the literature. For example, total sale or revenue (Adams & Ferreira, 2009; Hillman et al., 2007) , market capitalisation (Geiger & Marlin, 2012; Joecks et al., 2013) and total assets (Carter et al., 2003; Carter et al., 2010; Sila et al., 2016) . This study applies both total market capitalisation and total revenue as a proxy for company size. We do not use total assets as a control variable in this study because of the cancellation effect between the right-hand side control variable with the denominator of total assets in Tobin's Q.

Leverage is also a frequently used control variable in studies that examine board gender diversity and company financial performance (Adams & Ferreira, 2009; Schultz et al., 2010; Wang & Clift, 2009) . Highly leveraged companies required greater monitoring from management and boards and hence increase monitoring costs. The leverage level of a company is expected to have a negative correlation with company performance. We use the net gearing ratio as the proxy of a company's leverage level. It is measured by dividing the company's total debt to its total equity as followed:

$$\text{Net Gearing (NDE)} = \frac{\text{Short term debt} + \text{Long term debt} - \text{Cash}}{\text{Shareholders equity}}$$

Follow previous studies (Adams & Ferreira, 2009; Ahmed & Ali, 2017; Wintoki et al., 2012) , we also control for the volatility of return of the company. Volatility ROE measures company risk factor that influence company financial performance (Miller & Bromiley, 1990). Ahmed & Ali (2017) suggest that the volatility of company shares increase the uncertainty of holding costs of a company and hence affect the risk factor and share price as well as company financial performance measured in Tobin's Q. This study applies the volatility of return on

equity (VROE) as the proxy for company risk, which is measured by the standard deviation of the prior three years return on equity.

3.6 Empirical Methods

This study employs multiple regression analysis to test the hypotheses concerning the implications of board gender diversity on company performance. We use the statistical software, STATA 14, to run the diagnostic tests and the statistical regression analysis of the model. The following sub-section presents the methods of estimation of this study.

3.6.1 Panel Data

This study uses unbalanced panel data of 299 companies listed in the ASX200 index from the period 2008 to 2015. Panel data involves analysis of both cross sectional and time series dimensions of the sample set. Panel data controls for any unobserved variables and produces a consistent regression estimates. It also enables us to mitigate against any unobservable heterogeneity that may present in the sample. Panel data also provides more information and increases the degrees of freedom, results in less collinearity among the explanatory variables and improves the efficiency of the parameter estimates.

Furthermore, the dynamic relationships between company's past performance and current board structure cannot be estimated using cross-sectional data or a single time series data. Panel data allows the utilisation of the intercompany prior years' effects to estimate an unconstrained distributed lag model (Hsiao, 2014). The additional information in panel data also allows us to blend within company and between company information that enables a study to produce more reliable parameter estimates, which a single cross-sectional and an individual time series data are unable to address.

In panel data, the availability of repeated observations of a group of companies allow a study to detect the unobservable through a linear transformation by either

taking the differencing of the companies or taking the deviation from the mean across the individual company over time. For example, in a simple regression of $Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \varepsilon_{it,}$ with an error term (ε) that is independently, identically and distributed (i.i.d) over i and t with zero mean and variance equals to σ^2, the OLS regression will yield unbiased and consistent estimates (Hsiao, 2014). However, if the values of Z_{it} are unobservable and the covariance of X_{it} and Z_{it} are non zero [$Cov(X_{it}, Z_{it}) \neq 0$], then the OLS estimates can be biased. Therefore, if the values of Z stay constant over the entire period of examination for a particular company but vary across the sample companies, that is $Z_{it} = Z_i$, the estimate will take the first difference of an individual company over time with the model as $(Y_{it} - Y_{i,t-1}) = \beta_1(X_{it} - X_{i,t-1}) + (\varepsilon_{it} - \varepsilon_{i,t-1})$. Similarly, if the values of Z_{it} stay the same across all companies at time t, that is $Z_{it} = Z_t$, the estimate will take the deviation of mean across the companies at time t with the model as $(Y_{it} - mean Y_t) = \beta_1(X_{it} - mean X_t) + (\varepsilon_{it} - mean \varepsilon_t)$. Single cross-sectional data or single time series data cannot perform this transformation, unless we have an instrumental variable that correlates with X but does not correlate with Z and the error term. An OLS single cross-sectional regression or a single time series regression can result in biased estimates (Baltagi, 2008)

However, there are limitations in using panel data. Due to a wide-variety of variables or factors that can influence the company's performance, it is not possible to include all possible influencing variables in the model specifications. The challenging task in this situation is to establish a model that addresses the heterogeneity across companies over a period of times that are not captured on the right-hand side of the model. However, it is acceptable that insignificant variables are not to be included in the model specification because the main focus of a good model is not to capture the reality, but rather to achieve the essential factors that influence the outcomes (Hsiao, 2014). The next section discusses a variety of methods that address the limitations in panel data.

3.6.2 Diagnostic Tests

This study employs a number of diagnostic techniques to examine the dataset to ensure that the dataset is free from biases and are efficient before proceeding with the statistical tests. These diagnostic tests are multicollinearity, heteroskedasticity, Hausman test, unit roots and endogeneity tests.

3.6.2.1 Multicolinearity Test

A correlation matrix examines the data for multicollinearity. The general rule of thumb for identifying if multicollinearity exists between two variables is a correlation of 0.7 or higher. In a multiple regression analysis, multicollinearity among the variables will cause unstable parameter estimates and produce biased results. It may also undermine the significance of an explanatory variable and difficulty in demonstrating the impact of an explanatory variable on the dependent variable.

3.6.2.2 Heteroskedasticity Test

The heteroskedasticity test is to examine if the variance of the error terms is constant and uncorrelated to the variable in the model specification. The presence of heteroskedasticity in a model can cause an inefficient parameter estimate in a structural model because the variance in the model is not constant. In this study, we use Breusch-Pagan Lagrange Multiplier test to examine if pooled regression or random effects regression is more appropriate in the model with the following null hypothesis:

H_0: The variance in the model is constant, that is homoskedasticity

If Breusch-Pagan Lagrange Multiplier test rejects the null hypothesis with the probability chi-square of less than the critical value of five percent, this indicates that the variance of the error terms in the dataset is not constant. This suggests that standard errors robustness test is required in the estimation to examine the relationship between board gender diverse boards and company performance.

3.6.2.3 Hausman Test Of Fixed Effects And Random Effects Model

This study also carries out a Hausman test to determine if a fixed effects model or random effects model is more suitable for the dataset. In general, if there is no endogeneity concern between the error terms and the explanatory variable, random effects estimation provides the most efficient, consistent and unbiased parameter estimates. However, if an endogeneity issue due to the present of unobservable heterogeneity in the structural model, then a random effects model becomes inconsistent and the estimation can be biased. In this instance, fixed effects model is more appropriate (Wooldridge, 2010). Furthermore, when the estimation makes inferences on the outcomes of a sample data rather than a population, fixed effects model is preferred over random effects model. As mentioned in section 3.4, the general model specification of this study is: $P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \varepsilon_{it}$. This model will produce an unbiased estimate if the coefficient of the parameter is consistent across the individual companies and there is no correlation between the error terms and the explanatory variables, making the random effects model estimation most appropriate. However, if there is unobservable heterogeneity concern in the structural model and the possibility differences among the individual company component, then fixed effects model is more appropriate with the following model specification:

$$P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \delta_i + \gamma_t + \varepsilon_{it} \qquad t = 1\ldots\ldots t,\ i = 1\ldots\ldots n \quad \text{---------- (1a)}$$

Where:

- P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations
- GD – The time-invariant n*1 matrix of gender diversity measure across N observations
- CV – The time-invariant n*k matrix of the control variables across n observations
- β – The unknown k*1 vector of regression parameters
- δ_i – Company time-invariant fixed effects
- γ_t – Year dummy fixed effects

ε – A n*1 vector of the error term

i – The number of n observations of the sample

t – The time period of each financial year

k – The number of control variables used in the structural model

Referring to model (1a), δ_i and γ_t represent the company and time-specific effects. Hausman specification test allows this study to examine if the company and time specific effects δ_i and γ_t can be treated as random effects that are drawn from a population or fixed effects that are drawn from a sample (Baltagi, 2008). The hypothesis to test which model is more suitable for our dataset is:

H_0: There is no correlation between δ_i and γ_t with $\varepsilon_{it,}$ indicating that random effects model is more appropriate.

H_1: There is correlation between δ_i and γ_t with $\varepsilon_{it,}$ indicating that fixed effects model is more appropriate.

3.6.2.4 Durbin-Wu-Hausman Test For Endogeneity

This study also utilises Hausman test for fixed effects estimation to address the issue of inconsistent coefficients across the individual companies in the sample data and produce consistent parameter estimates. However, Sila et al. (2016) argue that a fixed effects estimator is insufficient to mitigate the presence of endogeneity if the explanatory variable is not exogenous to the dependent variable. We apply the Durbin-Wu-Hausman test for endogeneity to address the most detrimental problem in board diversity-performance studies and also to examine if an endogeneity issue exists in the structural model.

To examine if the variable of interest of this study, the proportion of female directors, is exogenous to the dependent variable, company performance, we hypothesise the null hypothesis as followed:

H_0: The variable of interest is exogenous.

H_1: The variables of interest are endogenous.

This hypothesis can be tested using the following statistics that has a Chi-square distribution with degrees of freedom equal to the k number of the β in equation (1a):

$$(\beta_{OLS} - \beta_{IV})^t [Var_{IV} - V_{OLS}]^{-1} (\beta_{OLS} - \beta_{IV}) \sim \chi^2 \text{ of the k number of } \beta \text{ in equation (1a)}$$

We first run the 2SLS instrumental variable analysis on the identified problematic explanatory variable (PFOB) with the specified external instrumental variable (FC) and all other control variables in the model. We then run the diagnostic test using the Durbin-Wu-Hausman's endogeneity test. If the result rejects the null hypothesis, this indicates that the variable of interest is endogenous to the dependent variable. This implies that using the fixed effects estimation is insufficient to deal with the endogeneity issue. In this instance, applying an external instrumental variable will be the appropriate method to address the endogeneity issue.

3.6.3 Multiple Regression Statistical Analysis

This study carries out a comprehensive analysis with various types of statistical methods to examine the effects on parameter estimates when applying different statistical methods in a governance-performance study, and more specifically board gender diversity and company financial performance study. We begin with the ordinary least square (OLS) pooled regression with random effects analysis, followed by the fixed effects model, the two-stage least squares (2SLS) instrumental variables method, Arellano and Bond (1991) and Blundell and Bond (1998) dynamic Generalised Method of Moments (GMM) methods. The most common empirical methods used in governance-performance studies before the year 2000 are random effects or pooled ordinary least square (OLS) regression and fixed effects linear regression. The existence of an ongoing endogeneity problem (Bota-Avram, 2013) in governance and performance studies led to the subsequent use of 2SLS instrumental variable, dynamic and system GMM methods to address the endogeneity issues.

The three possibility causes of endogeneity are unobserved heterogeneity, simultaneity and dynamic endogeneity (Wintoki et al., 2012). Unobserved heterogeneity exists due to the unobservable individual company-specific characteristics that influence the company's governance structure and performance. An example would be managers' capability and the CEO's experience, the company's risk and their risk tolerance, which may affect the company's performance. Simultaneity occurs when a company's board characteristics are simultaneously determined by its performance. For example, a company may choose the board characteristics and control mechanisms that suit the company's performance level or the expected company's performance. Dynamic endogeneity occurs when past indicator variables affect the current variables. In corporate governance and performance studies, this happens when the past performance influences the characteristics of the current board and performance control variables. An example would be that poor performing companies might choose to change the board structure to have stronger corporate governance control (Schultz et al., 2010).

The possibility of an endogeneity issue caused by at least one of the above causes will result in biased and inconsistent estimates in a study. It is plausible to make a valid inference without carefully addressing the possibility of any one of the sources of endogeneity (Bota-Avram, 2013). To address the endogeneity issue in a diversity-performance study when testing female board representation effects on company's performance, we need to consider all three possibilities endogeneity causes. The general statistical methods for dealing with the endogeneity problem are; fixed effects linear regression estimator, two-stage least square (2SLS) instrumental variable method, system GMM approach and dynamic GMM estimator. We will discuss each of these methods in the following section and the suitability of these methods in our analysis.

3.6.3.1 Ordinary Least Square Regression: Pooled Regression, Random Effects And Fixed Effects Estimation

The simple general linear regression of panel data can be specified as $Y_{it} = \beta_0 + \beta_i X_{it} + \varepsilon_{it.}$ The main feature of panel data is to control the impact of the unobserved heterogeneity in the model to produce unbiased and efficient parameter estimates. In governance characteristics and performance studies, the potential causes of omitted variables in a model are company specific time-invariant variables, time-specific company-invariant variables, and company-time varying variables. If the unobserved heterogeneity is company specific time-invariant, then the parameters β_0 and β_i stay the same for a given cross-sectional company but may vary across the cross-sectional companies. In this instance, the sampling distributions may change. The examples of the unobserved heterogeneity in time-invariant variables are CEO's ability, managers' / CEO's and board members' gender and social economic background. These characteristics stay constant for a given company but vary across the cross-section of companies in the sample over a period of time if there are no changes in board members. Time-specific company-invariant variables are variables that remain the same for all companies in the sample at a given period but may vary through a different period of study. The examples of this company-invariant variable are interest rates, government policies affecting the companies and market conditions. The company and time-varying variables are variables that exhibit variation across the cross-sectional companies in the sample set at a given period and also vary throughout the sample period. The examples of company and time-varying variables are company' profitability, revenue and market capitalisation.

In a panel data regression model, we assume that the unobserved heterogeneity in the simple regression model [$Yit = \beta0 + \beta iXit + \varepsilon it$] remains constant through time for a given cross-sectional company or remains the same across companies at a given period. With this assumption, the estimate produces unbiased parameters and controls for all three possible time-invariant, company-invariant and both company and time-invariant variables. In this instance, the effects of omitted variables can be absorbed in the intercept β0, and the generalisation of a

variable-intercept model for panel data can fit in very well in the linear regression model using panel data (Hsiao, 2014).

Three linear regression models can be used to examine the panel data. The fundamental pooled linear regression model in panel data can be specified in the ordinary least square estimation as $Y_{it} = \beta_0 + \beta_i X_{it} + \varepsilon_{it}$, where we use the variable-intercept model. The underlying assumptions are that all excluded omitted variables are absorbed in the intercept and remain constant across the cross-sectional data and over time. Under these assumptions, the pooled OLS estimator is the best linear unbiased estimator (Wooldridge, 2010). We can also include the unobserved company and time specific effects μ in the simple linear regression stated above as $Y_{it} = \beta_0 + \beta_i X_{it} + \mu_{it} + \varepsilon_{it}$, where μ_{it} is assumed to remain constant for a given company of i over time t and a given period of t over company i. We can treat the company and time specific effects μ_{it} as either fixed or random effects.

Hausman (1978) discovered in empirical testing that using fixed effects estimation produce a significantly different result from random effect estimation. The ideal approach to unify the fixed effects model and random effects model is by way of assuming that all effects are random. The fixed effects model is appropriate when a study makes inferences on the outcomes that are in the sample. A random effects model is more appropriate than fixed effects model when a study makes unconditional inferences concerning the population. When the company and time specific effects are treated as random, these effects can be considered either correlated or uncorrelated with the explanatory variables. However, when the company effects are regarded as fixed and vary across the companies in the sample of a study, and because of the possibility of multicollinearity between the company effects and other time-invariant variables, fixed effects estimation will be more appropriate. This study applies Hausman misspecification test to verify if the company and time specific effects μ can be treated as random effects that are drawn from the population or fixed effects from the sample. The null hypothesis for

this misspecification test is H_0: Cov (μ_{it}, X_{it}) = 0 and the alternative hypothesis is H_1: Cov (μ_{it}, X_{it}) $\neq$ 0.

The Hausman test examines if the difference in the coefficients is systematic. If the F-test reject the OLS random effects estimation, which is the null hypothesis, fixed effects panel regression will be more appropriate in a study. Using company fixed effects helps eliminate bias due to a constant omitted variable, while company and time fixed effects control for the economic-wide yearly fluctuations. For this study's general model (1), we separate the company and time specific effects μ into $\alpha_i + \gamma_t$, where α_i is the company fixed effects, and γ_t is the time-specific fixed effects. The general model using fixed effects panel regression estimation for this study is as follows:

$$P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \delta_i + \gamma_t + \varepsilon_{it} \qquad t = 1\ldots\ldots t,\ i = 1\ldots\ldots n \quad \text{---------- (1a)}$$

Where:

- P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations
- GD – The time-invariant n*1 matrix of gender diversity measure across N observations
- CV – The time-invariant n*k matrix of the control variables across n observations
- β – The unknown k*1 vector of regression parameters
- δ_i – Company time-invariant fixed effects
- γ_t – Year dummy fixed effects

- ε – A n*1 vector of the error term
- i – The number of n observations of the sample
- t – The time period of each financial year
- k – The number of control variables used in the structural model

Antonakis et al. (2010) indicate that OLS regressions tend to be negatively biased towards the result when there is an unobserved omitted variable in the

data. To mitigate this, we apply the fixed effects method to make up for any omitted variables. A dummy variable is created for each individual company that is unique to itself. By including fixed effects in the model, we eliminate any unobservable variables from the equation and use the least squares method to produce unbiased parameters. Adams & Ferreira (2009) suggest that omitted variables affect the board diversity's policy and performance relationship. They employ firm fixed effects in their analysis and show that firm fixed effects are significant in the results. Carte et al. (2010) also apply OLS fixed effects regression with time and firm fixed effects to mitigate omitted variables.

3.6.3.2 Two Stage Least Squares (2SLS) Instrumental Variable Method

Applying fixed effect estimator is insufficient to address the possibility of endogeneity that exists in the diversity-performance study (Sila et al., 2016). This is due to the fundamental key assumptions in the ordinary least squares regression. OLS method assumes that the explanatory variables are strictly orthogonal to the errors and the error terms are independently and identically normally distributed (i.i.d) with a mean zero and a variance equals to σ^2. It means that an unbiased estimation of the relationship between governance characteristics and performance can only be estimated when the expected value of the dependent variable is a function of the exogenous explanatory variables.

It is also ambiguous whether gender-diverse boards affect company financial performance or whether there exists a simultaneous causality between female representation on boards and company financial performance due to self-selection process. Self-selection processes influence the appointment decisions on the board of directors that determine the diversity of the board structure. These endogeneity problems can lead to biased and unreliable findings if it is not being addressed appropriately.

It is a general consensus that a better strategy in dealing with endogeneity is by identifying a truly exogenous instrumental variable. However, finding a truly exogenous variable is challenging. Adams and Ferreira (2009) use fraction of male

directors with board connections to female directors as their instrumental variable. They argue that greater gender diversity is observed if the male directors are more connected to the female directors. Adams and Ragunathan (2017) replicate this concept by applying the average number of years that bank directors interact with female executives or directors from other industries as their instrumental variable. Ahern and Dittmar (2012) use pre-quota cross-sectional variation in female board representation as an instrument for exogenous changes to corporate boards following the quota introduction in Norway.

As explained in section 3.3.5, this study introduces a unique external instrumental variable by applying the influence of political science in corporate governance (Terjesen et al., 2015) and the theory of "economic ramification of distance" (Bouwman, 2012) in developing the exogenous external instrumental variable. We believe that female politicians play an important role in influencing other females' involvement in politics as well as in the workforce. As a country's institutional environment co-evolves with gender corporate policies (Terjesen et al., 2015), the representation of local female councillors has a positive influence on the experienced and skills females acquire to excel as directors on corporate boards. The parallel argument is that as females achieve leadership positions in other areas of society, we should also expect to see increasing numbers of female representation on corporate boards. This study applies the concept of geography influence of female councillors in local governments and links the headquarter office of the sample ASX200 companies to their respective local governments. By combining these two perspectives of the influence of gender on workforce participation, it is hoped that a more robust instrumental variable will address the endogeneity issue.

The first justification to employ an instrumental variable method is the presence of an endogenous regressor in the model. In general, OLS is the most efficient and consistent method for estimating the parameters in the regression model. However, if an endogeneity issue is the concern in a study, an endogeneity test is required to justify the application of any other analytical method. Although the

instrumental variable approach is consistent with the estimates, the use of an instrumental variable method needs to be balanced against the possible loss of efficiency of the OLS method. We apply Durbin-Wu-Hausman's endogeneity test to examine if endogeneity issue is present in the model and to test if the OLS method is inconsistent. If the test suggests that the endogeneity issue exists in the model, then the 2SLS instrumental variable method is more appropriate in estimating the structural equation of the model rather than OLS.

An endogenous variable is one that correlates with the error terms in the model. In relation to this study, there is a likelihood that the problematic variable of interest, the proportion of female directors on boards, is endogenously determined with company performance. In this case, the coefficient of the proportion of female directors variable cannot be interpreted as capturing the effect of company financial performance due to confounding factors. This means that the endogenous variable is jointly determined with the dependent variable within the model. This study introduces an external instrumental variable that is uncorrelated with the disturbance term but correlated with the endogenous variable into the model equation to overcome the possibility of simultaneous causality between the endogenous variable and the dependent variable. With this in place, this estimation should capture only the effects on the dependent variable on changes in the explanatory variables induced by the external instrumental variable. This study applies the Durbin-Wu-Hausman test to examine if there exists an endogenous explanatory variable in the structural model.

To reiterate the general model specification of this study, the pooled OLS model is specified as model (1) and the fixed effects model includes both time-invariant and company-invariant effects is defined as model (1a) as follows:

$$P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \varepsilon_{it} \qquad t = 1\ldots\ldots t,\ i = 1\ldots\ldots n \quad \text{---------- (1)}$$

$$P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \delta_i + \gamma_t + \varepsilon_{it} \qquad t = 1\ldots\ldots t,\ i = 1\ldots\ldots n \quad \text{---------- (1a)}$$

Where:

P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations

GD – The time-invariant n*1 matrix of gender diversity measure across N observations

CV – The time-invariant n*k matrix of the control variables across n observations

β – The unknown k*1 vector of regression parameters

δ – Company time-invariant fixed effects

γ – Year dummy fixed effects

ε – A n*1 vector of the error term

i – The number of n observations of the sample

t – The time period of each financial year

k – The number of control variables used in the structural model

Hermalin and Weisback (2001) indicate that the endogeneity issue exists in examining board composition and companies performance due to reverse causality of the variables. In this instance, the parameter estimates in the fixed effects estimation as stated in equation (1a) above can be biased if the dependent variable and explanatory variable are endogenous, specifically the company financial performance measure (Tobin's Q) and the proportion of females on boards (PFOB).

This study deals with the possibility of an endogeneity issue in the model by way of identifying a truly exogenous instrumental variable, the proportion of local female councillors. When applying an external instrumental variable regression in equation (1) or (1a), the external instrumental variable breaks the endogenous variable, the proportion of female directors on boards (PFOB), into two parts. The first part of the proportion of female directors on boards (PFOB) is correlated with ε and the second part is not correlated with ε. We can only estimate the coefficient of the proportion of female directors on boards by isolating the part that is not correlated with ε using the external instrumental variable. This external instrumental variable method detects the changes in the proportion of female

directors on boards that are not correlated with ε. It produces an unbiased parameter estimate to explain the relationship between gender-diverse boards and company performance.

A valid external instrumental variable needs to fulfil two conditions. The first condition in applying an external instrumental variable requires that there is no correlation between the valid external instrumental variable and the error term of the dependent variable in the model equation. In this study, the proportion of local female councillors (FC) is not correlated to the error terms of the equation or the company financial performance of the ASX200 companies. The second condition in applying an external instrumental variable requires that a relevant and informative external instrumental variable to be correlated with the problematic variable of interest. In this study, the proportion of local female councillors (FC) is found to be correlated to the proportion of female directors on boards (PFOB) of the ASX200 sample companies.

In statistical terms, the first condition means that the instrumental variable must be exogenous and uncorrelated with the error terms in the model. This can be tested using Hansen's over-identifying J-test, which is a Chi-squared test of whether the selected instrumental variable is uncorrelated with the error term as follows:

i) Cov (FC, ε) = 0, indicate the instrument's exogeneity.

Where:

FC – the external instrument variable – the proportion of female councillors in the local government

ε – The error term in equation (1) or (1a), that is any other variables that is not indicated in the system that relates to the company financial performance measure (Tobin's Q) of the company

The second requirement is that the instrumental variable must be correlated with the endogenous explanatory variable. This can be verified with the F-test by performing the first-stage regression of the endogenous variable on the selected instrumental

variable. This means that the covariance of the instrumental variable and the endogenous variable must be non-zero as:

ii) Cov (FC, PFOB) $\neq$ 0, indicate the instrument relevance;

Where:

FC – the external instrument variable – the proportion of female councillors in the local government

PFOB – the proportion of female directors on boards

To fulfil the first condition, we first apply economic theory to assume that Cov (FC, ε) = 0. This is due to the presumption that the OLS estimator of ε is biased due the presence of an endogeneity problem in the structural model. As such, we are unable to test if Cov (FC, ε) = 0 because we do not have an unbiased estimator for ε. If we are correct in our assumptions about the external instrumental variable, the proportion of local female councillors, then we argue that it is unlikely that there is a correlation between the proportion of local female councillors and the companies performance, that is Cov (FC, ε) = 0. Therefore:

$$\alpha_1{}^{Z} = \frac{Cov(PFOB,Z)\beta_1 + Cov(\varepsilon,Z)}{Cov(PFOB,Z)} = \frac{Cov(PFOB,Z)\beta_1}{Cov(PFOB,Z)} = \beta_1$$

Statistically, we can test the exogeneity of the external instrumental variable in the differenced or system Generalised Method of Moments (GMM) using Hansen J-test of exogeneity of the instrument. We will discuss this test in GMM section later in this chapter. Upon confirming the first condition of the validity of the external instrumental variable, this study applies 2SLS instrumental variable method to justify the second condition of applying an external instrumental variable, that is the relevancy of the external instrumental variable in examining the relationship between gender diversity and company performance. The first stage of the 2SLS analysis enables the justification of the correlation between the external instrumental variable and the endogenous variable, which is the relationship between the proportion of local female councillors (FC) and the proportion of female directors on boards (PFOB) of the ASX200. The second

stage of the analysis reveals the relationship between board gender diversity and company performance. The purpose of using 2SLS over OLS is to mitigate the possibility of an endogeneity problem and provide consistent unbiased parameter estimates.

Revisiting our general structural equation (1), $P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \varepsilon_{it}$, as there is a possibility that board gender diversity (GD) measured by PFOB might be endogenous with P, we cannot trust the estimate of β_1. However, we can use an instrumental variable estimate of β_1 using mathematic reasoning as follows:

$$\alpha_1^{FC} = \frac{\mathrm{Cov}(P,FC)}{\mathrm{Cov}(PFOB,FC)} = \frac{\mathrm{Cov}(\beta 0 + \beta 1 PFOB + \varepsilon, FC)}{\mathrm{Cov}(PFOB,FC)} = \frac{\mathrm{Cov}(PFOB,FC)\beta 1 + \mathrm{Cov}(\varepsilon,FC)}{\mathrm{Cov}(PFOB,FC)}$$

Where:

α_1^{FC} – the coefficient of the instrumental variable

To fulfil the second condition of instrumental variable estimation, we need to isolate the part of PFOB that is not correlated with the error term, ε. To do this, we regress the endogenous variable of interest, the proportion of female on boards (PFOB), with the selected external instrumental variable, the proportion of local female councillors (FC) in the first stage regression using ordinary least squares as follows:

$$GD_{it} = \alpha_0 + \alpha_1 FC + \alpha_k CV_{it} + v_{it} \qquad t = 1.\ldots\ldots t,\ i = 1.\ldots\ldots n \quad \text{---------- (2)}$$

Where:

GD – The gender diversity measure across N observations

FC – The instrumental variable, the Proportion of female councillors in the local government

CV – The time-invariant n*k matrix of the control variables across n observations

α – The unknown regression parameters

v – The error term

i – The number of n observations of the sample

t – The time period of each financial year

k – The number of control variables used in the structural model

By testing the null hypothesis, H_0: $\alpha_1 = 0$ and the alternative hypothesis, H_1: $\alpha_1 \neq 0$, we are examining if Cov (FC, PFOB) $\neq 0$. The key identification condition is that the coefficient of the instrumental variable, $\alpha_1 \neq 0$. This indicates that the selected external instrumental variable, the proportion of local female councillors (FC), is relevant to the endogenous variable of interest, the proportion of female directors on boards (PFOB).

As OLS and 2SLS instrumental variable methods both provide consistent estimates, 2SLS instrumental variable method is inefficient. OLS estimation is preferred to the 2SLS instrumental variable method when the explanatory variables are strictly exogenous to the dependent variable in a structural model. In this instance, we need to be able to test if the endogeneity problem is present in the general equation (1) or (1a). This study applies Durbin-Wu-Hausman Test to examine if the OLS estimates and 2SLS instrumental variable methods are different. Hausman (1978) suggests that we need to compare the OLS and 2SLS instrumental variable estimates to determine if the differences are significant. The 2SLS instrumental variable method will only be applied when there exists an endogeneity problem in the estimation. If there is a significant difference between the two methods, we can conclude that the proportion of female directors on boards (PFOB) is an endogenous variable.

Considering the original regression in the general equation 1:

$$P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \varepsilon_{it} \qquad t = 1\ldots\ldots t,\ i = 1\ldots\ldots n \quad \text{---------- (1)}$$

If board gender diversity (GD) measured by the proportion of female directors on boards (PFOB) is exogenous to company financial performance (P), OLS estimation as equation (1) will produce unbiased estimates and is more efficient compared with the 2SLS instrumental variable method. The first stage regression in equation (2) examines if the selected external instrumental variable, the proportion of local female councillors (FC), is significant and relevant to the endogenous variable of interest, the proportion of female directors on boards (PFOB). If the external instrumental variable is relevant and exogenous with the

endogenous variable of interest, we will conduct an auxiliary regression to test if there exists an endogeneity problem.

Referring to equation 2:

$$GD_{it} = \alpha_0 + \alpha_1 FC + \alpha_k CV_{it} + v_{it} \qquad t = 1.\ldots\ldots t,\ i = 1.\ldots\ldots n \quad \text{---------- (2)}$$

If the external instrumental variable fulfilled the two fundamental conditions, in which Cov (FC, GD) $\neq$ 0 (indicates the instrument relevance) and Cov (FC, ε) = 0 (indicates the instrument's exogeneity), then GD is uncorrelated with ε in equation (1) only if v in equation (2) is uncorrelated with ε. To test this, we run the following regression using OLS as follows:

$$P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \beta_2 v_{it} + \varepsilon_{it} \qquad t = 1.\ldots\ldots t,\ i = 1.\ldots\ldots n \quad \text{---------- (2a)}$$

Where:

- P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations
- GD – The time-invariant n*1 matrix of gender diversity measure across n observations
- CV – The time-invariant n*k matrix of the control variables across n observations
- β – The unknown k*1 vector of regression parameters
- v – The residual value of the instrumental variable estimation in equation (2)
- ε – A n*1 vector of the error term
- i – The number of n observations of the sample
- t – The time period of each financial year
- k – The number of control variables used in the structural model

The hypothesis to test if there is an endogeneity problem in the estimates is as follows:

H_0: The coefficient of $v_{it} = 0$, means that Cov ($GD_{it,}$ ε_{it}) = 0
H_1: The coefficient of $v_{it} \neq 0$, means that Cov ($GD_{it,}$ ε_{it}) ≠ 0

If the results from the standard t-test reject H_0, this indicates that Cov ($GD_{it,}$ ε_{it}) ≠ 0, we can conclude that GD is endogenous since v_{it} and ε_{it} will be correlated. In this instance, the OLS methods are biased, as there is an endogenous explanatory variable in the equation model (Larcker & Rusticus, 2010). To mitigate the endogenous problem, we need to apply 2SLS instrumental variable estimation by applying the predicted value of females on boards into equation (1) in the 2SLS estimation. The second stage of the regression will replace the gender diversity measure, GD, with the predicted value of the gender diversity measure, $\widehat{GD}$. The structural equation for the 2SLS with instrumental estimation is as follows:

$P_{it} = \beta_0 + \beta\widehat{GD}_{it} + \beta_k CV_{it} + \varepsilon_{it}$ t = 1…….t, i = 1……n ---------- (2b)

Where:

P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations

$\widehat{GD}$ – The time-invariant n*1 matrix of predicted value of gender diversity measure across n observations after taking into consideration of instrumental variable estimation

CV – The time-invariant n*k matrix of the control variables across n observations

β – The unknown k*1 vector of regression parameters

ε – A n*1 vector of the error term

i – The number of n observations of the sample

t – The time period of each financial year

k – The number of control variables used in the structural model

If both fundamental conditions are satisfied, the 2SLS instrumental variable method will be an unbiased estimator of β_1. By applying the external instrumental variable into the model equation using the predicted value of GD, we ignore the residual value from the original OLS estimation in equation (1). The 2SLS instrumental variable method has stripped off any endogenous relationships between the proportion of female directors on boards and company financial performance by using the exogenous shock of the instrumental variable (Larcker & Rusticus, 2010).

3.6.3.3 Dynamic Generalised Method of Moments (GMM)

By nature, many economic relationships between the variables in a study are dynamic (Baltagi, 2008). In parallel, the relationships between board gender diversity and company financial performance may also be dynamic. These dynamic relationships can be explained with a lagged dependent variable in this study, the company past performance. Using panel data allows us to understand the dynamic correlations between the dependent variable and the regressors. However, using lagged dependent variables in the model may cause some problems. As the dependent variable is the function of the error terms in the model, the lagged dependent variable follows through as the function of the error term too. In this instance, the lagged dependent variable at the right-hand side of the model will be correlated with the error term. If we apply OLS estimator to examine the relationships, the estimated parameter will be biased and inconsistent (Anderson & Hsiao, 1981). Nickell (1981) also discovered that the fixed effect estimator is also biased and inconsistent because the lagged variable is correlated with the time-invariant fixed effect in the model. The random effect estimator is also biased when there exist dynamic relationships in the model (Baltagi, 2008). Anderson and Hsiao (1981) wipe out the individual fixed effects by introducing the first difference transformation in the model to include the first difference of the explanatory variables as the internal instrumental variables. These instrumental variables will not be correlated with the error term. This first difference method is consistent in estimating the relationships between the variables but is not efficient because it does not utilise all the available moment conditions (Ahn & Schmidt,

1995) . Arellano and Bond (1991) introduced a Generalised Method of Moments (GMM) procedure that solves the efficiency issue in the first difference method.

Hansen (1982) developed the Generalised Method of Moments (GMM) framework and Anderson and Hsiao (1981) extended the GMM framework and suggested using more lags of the level or differencing of the dependent variable as the internally generated instrumental variables in the dynamic panel data model. Building on Anderson and Hsiao's (1981) concept, Arellano and Bond (1991) include the lags of the dependent variable as covariates and unobserved random and fixed panel-data effects in the dynamic panel data models to derive a consistent and efficient Generalised Method of Moments estimator for the parameters in the model. They suggest that there are many more instrumental variables available in the general structural model setting, in which more lags of the dependent variables can be included as the instrumental variables, and the predetermined variables and endogenous variables are potentially the valid instrumental variables. To exploit the dynamic relationships between the dependent variable and the explanatory variable, they use the instrumental matrix to combine the lagged dependent variable with first differences of the strictly exogenous variables with predetermined variables and endogenous variable in the dynamic GMM estimator. Previous literatures in economics and finance areas employed this dynamic approach and suggest that there exist a dynamic relationship between dependent and explanatory variables (Beck, Levine, & Loatza, 2000; Bond & Meghir, 1994; Hoechle, Schmid, Walter, & Yermack, 2012) . This dynamic GMM method requires that there is no auto-correlation in the idiosyncratic errors.

Semykina & Wooldridge (2010) and Roodman (2009b) indicate that if there is a dynamic relationship between the current values of an explanatory variable and the past performance of the dependent variable, fixed effects regression may be positively biased. Wontoki et al. (2012) and Schultz et al. (2010) apply the dynamic panel GMM by using current values of governance variables as a function of past company performance. Carter et al. (2010) and Garay and Gonzalez

(2008) also use lagged dependent variables in their analysis to address endogeneity problems. They recognize the fact that it is difficult to identify natural experiments or exogenous external instrumental variables in corporate governance research and this may potentially result in bias estimates from unobservable heterogeneity.

To illustrate the GMM moment conditions, we base upon the structural equation (1) and (2) of this study[19] and redefine the normal OLS equations for the GMM moment conditions as (1_{GMM}) and (2_{GMM}) as follows:

$$P = \beta_0 + \beta_1 GD + \beta_k CV_1 + \varepsilon \quad \text{---------- } (1_{GMM})$$

$$GD = \alpha_0 + \alpha_1 FC + \alpha_k CV_2 + v \quad \text{---------- } (2_{GMM})$$

The GMM moment conditions regress the dependent variable, company financial performance measure (P) in the first three conditions. The error term equals to mean zero in the first condition and the error term in the second and third condition is uncorrelated with the explanatory variables. We then regress the endogenous explanatory variable in the remaining forth through sixth moment conditions. In this instance, the GMM moment conditions will nest all the endogenous estimations and provide another way to consider the instrumental variable estimator. The GMM moment conditions is as follows:

$$E = \begin{bmatrix} P - \beta_0 - \beta_1 GD - \beta_k CV_1 \\ (P - \beta_0 - \beta_1 GD - \beta_k CV_1)\,(GD) \\ (P - \beta_0 - \beta_1 GD - \beta_k CV_1)\,CV_1 \\ GD - \alpha_0 - \alpha_1 FC - \alpha_k CV_2 \\ (GD - \alpha_0 - \alpha_1 FC - \alpha_k CV_2)\,(P) \\ (GD - \alpha_0 - \alpha_1 FC - \alpha_k CV_2)\,CV_2 \end{bmatrix} = 0$$

[19] $P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \varepsilon_{it}$ ---------- (1)

$GD_{it} = \alpha_0 + \alpha_1 FC_{it} + \alpha_k CV_{it} + v_{it}$ ---------- (2)

The endogenous variables, the company financial performance (P) and the gender diversity measure (GD) are in the bracket. To get the instrumental variable estimators, we replace the endogenous variable P and GD with instruments CV_1 and CV_2 and yield the following moment conditions:

$$E = \begin{bmatrix} P - \beta_0 - \beta_1 GD - \beta_k CV_1 \\ (P - \beta_0 - \beta_1 GD - \beta_k CV_1)\ (CV_2) \\ (P - \beta_0 - \beta_1 GD - \beta_k CV_1)\ CV_1 \\ GD - \alpha_0 - \alpha_1 FC - \alpha_k CV_2 \\ (GD - \alpha_0 - \alpha_1 FC - \alpha_k CV_2)\ (CV_1) \\ (GD - \alpha_0 - \alpha_1 FC - \alpha_k CV_2)\ CV_2 \end{bmatrix} = 0$$

The instrumental variable system as shown in the GMM moment conditions above is identified and has a unique equation for every parameter.

In differenced GMM, we estimate the whole equation (1) in changes and add a lagged dependent variable to account for the dynamics of the relationship in the structural model as follows:

$$P_{it} = \beta_0 + \beta_1 P_{it-1} + \beta_2 GD_{it} + \beta_k CV_{it} + \varepsilon_{it} \qquad t = 1.\ldots\ldots t,\ i = 1.\ldots\ldots n \quad \text{---------- (3)}$$

Where:

- P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations
- GD – The time-invariant n*1 matrix of gender diversity measure across n observations
- CV – The time-invariant n*k matrix of the control variables across n observations
- β – The regression parameters
- ε – A n*1 vector of the error term
- i – The number of n observations of the sample
- t – The time period of each financial year
- k – The number of control variables used in the structural model

We then take the first difference of equation (3) as follows:

$$P_{it-1} = \beta_0 + \beta_1 P_{it-2} + \beta_2 GD_{it-1} + \beta_k CV_{it-1} + \varepsilon_{it-1} \qquad t = 1\ldots\ldots t,\ i = 1\ldots\ldots n \text{ ------ (4)}$$

To estimate the equation in changes form, we subtract (3) and (4) to derive the following equation:

$$\Delta P_{it} = \beta_1 \Delta P_{it-1} + \beta_2 \Delta GD_{it} + \beta_k \Delta CV_{it} + \Delta\varepsilon_{it} \text{ --------- (5)}$$

Where:

- P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations
- Δ - The time-differencing operator
- GD – The time-invariant n*1 matrix of gender diversity measure across n observations
- CV – The time-invariant n*k matrix of the control variables across n observations
- β – The regression parameters
- ε – A n*1 vector of the error term
- i – The number of n observations of the sample
- t – The time period of each financial year
- k – The number of control variables used in the structural model

In equation (5), the differenced of equation (3) and (4) cancels off the intercept and the error term will now be correlated. The instruments are at t-2 because the change in the control variables is from t-1 to t. The differenced GMM moment conditions using this approach are as follows:

$$E = \begin{bmatrix} \Delta P_{it} - \beta_1 \Delta P_{it-1} - \beta_2 \Delta GD_{it} - \beta_k \Delta CV_{it} \\ (\Delta P_{it} - \beta_1 \Delta P_{it-1} - \beta_2 \Delta GD_{it} - \beta_k \Delta CV_{it})\ GD_{it-2} \\ (\Delta P_{it} - \beta_1 \Delta P_{it-1} - \beta_2 \Delta GD_{it} - \beta_k \Delta CV_{it})\ CV_{it-2} \end{bmatrix} = 0$$

The first differenced equation above eliminates any time-invariant unobserved heterogeneity due to any potential bias in the model. The second step in applying dynamic GMM is to use lagged explanatory variables as the instruments for the current explanatory variables in the model. In this instance, we draw a set of historical values of the dependent variable and explanatory variables as instruments for the changes in company performance, the board structure variables, and firm-level control variables.

Despite the ability of dynamic GMM in addressing the endogeneity issue in board gender diversity and company financial performance studies using internally generated instruments, there are three econometric shortcomings in applying dynamic GMM. First, the differenced model reduces the power of the estimation in the original model specification by reducing the number of observations in explanatory variables (Beck et al., 2000) . Second, the internally generated instruments in levels may be weak for the first-differenced estimations (Arellano & Bover, 1995) Third, if there is a measurement error on the dependent variables, the first differencing may exacerbate the measurement error's issue (Griliches & Hausman, 1986) .

Given the shortcomings as mentioned earlier, Arellano and Bover (1995) and Blundell and Bond (1998) improved this dynamic GMM method by including both levels and differenced equations in the estimations using dynamic panel system GMM.

Dynamic Panel System Generalised Method of Moments (DPS-GMM) estimator is proposed by Arellano and Bover (1995) and Blundell and Bond (1998) . While differenced GMM treats all the explanatory variables as endogenous, system GMM with the equation in difference form, instrumented the lagged differences in both lagged and the equation levels. This system simultaneously estimates the model in both level and differences by adding the level equation into the differenced GMM in the dynamic equation as follows:

$$P_{it} = \beta_1 P_{it-1} + \beta_2 GD_{it} + \beta_k CV_{it} + \varepsilon_{it}$$

$$\Delta P_{it} = \beta_1 \Delta Perf_{it-1} + \beta_2 \Delta GD_{it} + \beta_k \Delta CV_{it} + \Delta\varepsilon_{it} \quad \text{-------(6)}$$

Where:

Δ	– The time-differencing operator
P	– The n*1 vector of company financial performance measured by Tobin's Q, across n observations
GD	– The time-invariant n*1 matrix of the board gender diversity, measured across n observations
CV	– The time-invariant n*h matrix of the control variables across n observations
β	– The regression parameters
ε	– The n*1 vector of error term across n observations
i	– The number of n observations of the samples
t	– Time period of each financial year
k	- The number of control variables used in the structural model

Equation (6) presents both the levels and difference form where the first equation is the structural model in levels and the second equation is the lagged differences in difference form. The GMM moment conditions in system GMM can be specified as follows:

$$E = \begin{bmatrix} P_{it} - \beta_1 P_{it-1} - \beta_2 GD_{it} - \beta_k CV_{it} \\ (P_{it} - \beta_1 P_{it-1} - \beta_2 GD_{it} - \beta_k CV_{it})(\Delta GD_{t-2}) \\ (P_{it} - \beta_1 P_{it-1} - \beta_2 GD_{it} - \beta_k CV_{it})(\Delta CV_{it-2}) \\ \Delta P_{it} - \beta_1 \Delta P_{it-1} - \beta_2 \Delta GD_{it} - \beta_k \Delta CV_{it} \\ (\Delta P_{it} - \beta_1 \Delta P_{it-1} - \beta_2 \Delta GD_{it} - \beta_k \Delta CV_{it})\ (GD_{it-2}) \\ (\Delta P_{it} - \beta_1 \Delta P_{it-1} - \beta_2 \Delta GD_{it} - \beta_k \Delta CV_{it})\ CV_{it-2} \end{bmatrix} = 0$$

Blundell and Bond (1998) obtain the first stage instrument variable regression by running past company financial performance on current company performance. Next, they use the extended system GMM that uses the differences of past company financial performance as an instrument in the level, in addition to lagged levels of company performance. By taking into consideration of both level and difference equations in the system, this allows more instruments to be included in the estimate and provides a more efficient hypothesis test while controlling for time-invariant unobserved heterogeneity (Roodman, 2009a). If there are valid relationships between board gender diversity and company financial performance at level, system GMM will provide a more accurate specification than the dynamic differenced GMM. However, if the relationship is persistent at the levels, the differenced equation with lagged levels of the variables will be considered due to weak instruments. In this instance, the system GMM augments the moment conditions by using the lagged differences of company financial performance as instruments for the levels of board gender diversity and company financial performance relations (Schultz et al., 2010) .

Furthermore, the system GMM estimator is capable of detecting potential omitted variables by using two tests. First, the test of second-order autocorrelation that assumes the model is completely dynamic when sufficient lags are included in the model. In this case, no serial correlation remains in the residual value. Second, as there are more than one lag of past company financial performance measure can be used in the model, we can use over-identifying restrictions test to examine the null hypothesis, which is to test if all instrumental variables are jointly valid (Hansen, 2012) . System GMM is more superior than differenced GMM as it enables the correction for unobserved company-level heterogeneity, omitted variable bias, measurement error and potential endogeneity that frequently affect growth estimation (Bond, 2002).

This study examines the suitability of system GMM with the structural model and relies on the assumption that all time variants influence female representation on boards and company financial performance are included in the model, or alternatively, the influence of time variants on female board representation is channelled through past company performance. Based on the insight of system GMM, this study employs the rationale that past company financial performance measures influence the appointment of board of directors are not correlated with the current error term in the first differences ($\Delta\varepsilon_{i,t}$) and the past performance measures in first differences are not correlated with the error term in levels ($\varepsilon_{i,t}$).

As noted at the beginning of this section, the dynamic GMM method requires that there is no auto-correlation in the idiosyncratic errors. We utilise the diagnostic test in GMM estimation to examine the first difference residuals for auto-correlations using Arellano-Bond test of second-order serial correlation. The null hypothesis to test the error term of the differenced GMM model is: H_0: There is a no second-order serial correlation in the model, particularly at the second order. Therefore, the estimate of AR(2) should have a p-value of more than 10% and not reject the hypothesis in order to fulfil the requirements of no auto-correlation in the idiosyncratic errors. This indicates that the error terms in the estimated model are not serially correlated and there are enough lags of the instrumental variables to control for the dynamic relationship in the model.

We also follow Roodman's (2009b) recommendation in implementing dynamic GMM model and applying Hansen J-test of over-identifying restriction and the difference-in-Hansen test of exogeneity of instrument subsets. The null hypothesis for Hansen J-test of over-identification is the instruments are valid. To ensure that there is no over-identification of instruments in the structural model, the chi-square test statistics in Hansen-J-test of over-identifying should not reject the null hypothesis, indicating that the instruments are valid. The rejection of the null hypothesis suggests that instruments are not valid and the estimation of the model is weak. For the difference-in-Hansen test of exogeneity, the null hypothesis is the instruments are exogenous, meaning that the instruments are not correlated with

the dependent variable. If the chi-square test statistics report a significant p-value and reject the hypothesis, this invalidates the exogeneity of the instruments. We expect a chi-square test statistics of more than 10% level of p-value to validate the exogeneity of the instruments.

3.6.3.4 Kanter's Critical Mass And Tokenism Method

Section 3.5.2.3 presented the board gender diversity measured by Kanter's critical mass. As mentioned, this study categorises critical mass into two categories, the Kanter's gender classifications and the amended critical mass classification based on the incremental proportion of female directors on boards. Kanter's critical mass theory suggests that males with masculine traits dominate corporations' structure, especially at the top management and board level. Hence, to examine the second hypothesis of this study whether the critical mass of female directors has any implications on company performance, we apply the same statistical methodologies as demonstrated in section 3.5.2.3. We run all the statistical methods, pooled OLS estimation, fixed and random effects model, 2SLS instrumental variable model, dynamic differenced GMM and system GMM estimations; to examine the relationship between the critical mass of the proportion of female directors on boards and company performance. To reiterate, Kanter's categories of four gender diversity groupings are:

i. Uniform group: K1 equals one when board consists of all male directors and zero otherwise;
ii. Skewed group: K2 equals one when there is at least one female director but less than twenty percent female directors on boards, and zero otherwise;
iii. Tilted group: K3 equals one when there is at least twenty percent but not more than forty percent of female directors on boards, and zero otherwise;
iv. Balanced group: K4 equals one when there are at least forty percent of female directors on boards, and zero otherwise.

This study extends Kanter's gender diversity groupings with some modifications for better analysis of the data. We categorise the gender grouping based on the incremental proportion of female directors on boards as follows:

i. ACM0 – Dummy variable equals one when board has no female director and zero otherwise;
ii. ACM20 – Dummy variable equals one when there is at least twenty percent of female directors on boards and zero otherwise;
iii. ACM30 – Dummy variable equals one when there is at least thirty percent of female directors on boards and zero otherwise; and
iv. ACM40 – Dummy variable equals one when there is at least forty percent of female directors on boards and zero otherwise.

The amended board gender diversity grouping is based on the reasoning that the entire sample set is captured in the analysis with realistic comparisons. For example, if the gender groups are classified according to Kanter's grouping, for the skewed groups (K2), the dummy variable is assigned to boards with at least one female director but less than twenty percent of female directors. There are two possibilities in applying the sample set. First, if the skewed group (K2) is compared to the uniform group of boards with no female directors on board (K1), the entire sample set is not being included because the boards with more than twenty percent of female directors are not included. Second, if we employ the entire dataset, this skewed group (K2) will be compared to uniform groups (K1) as well as tilted groups (K3) and balanced groups (K4). In this instance, we will not be able to ascertain the effective proportion of female directors on boards to have an impact on the company performance. However, with the modification of the grouping and classification, we categorise the group based on the increment proportion of female directors on boards. This modification allows us to examine the implications of the incremental effect of female directors on company performance. Furthermore, this allows us to compare the boards with fewer female board representations with boards with the higher proportion of female directors whilst utilising the entire dataset.

The model specification for critical mass is as follows:

$$P_{it} = \beta_0 + \beta_1 CMGC_{it} + \beta_k CV_{it} + \alpha_i + \gamma_t + \varepsilon_{it} \text{ ---------- (7)}$$

Where:

P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations

CMGD – The time-invariant n*1 matrix of critical mass gender classification groupings measures across N observations

K1 – Uniform group, boards with all male director

K2 – Skewed group, boards with at least one but less than twenty percent of female directors on boards

K3 – Tilted group, boards with twenty percent but less than forty percent of female directors

K4 – Balanced group, boards with at least forty percent of female directors

ACM0 – Boards with predominantly male directors

ACM20 – Boards with at least twenty percent of female directors

ACM30 – Boards with at least thirty percent of female directors

ACM40 – Boards with at least forty percent of female directors

CV – The time-invariant n*k matrix of the control variables across n observations

β – The unknown k*1 vector of regression parameters

δ – Company time-invariant fixed effects

γ – Year dummy fixed effects

ε – A n*1 vector of the error term

i – The number of n observations of the sample

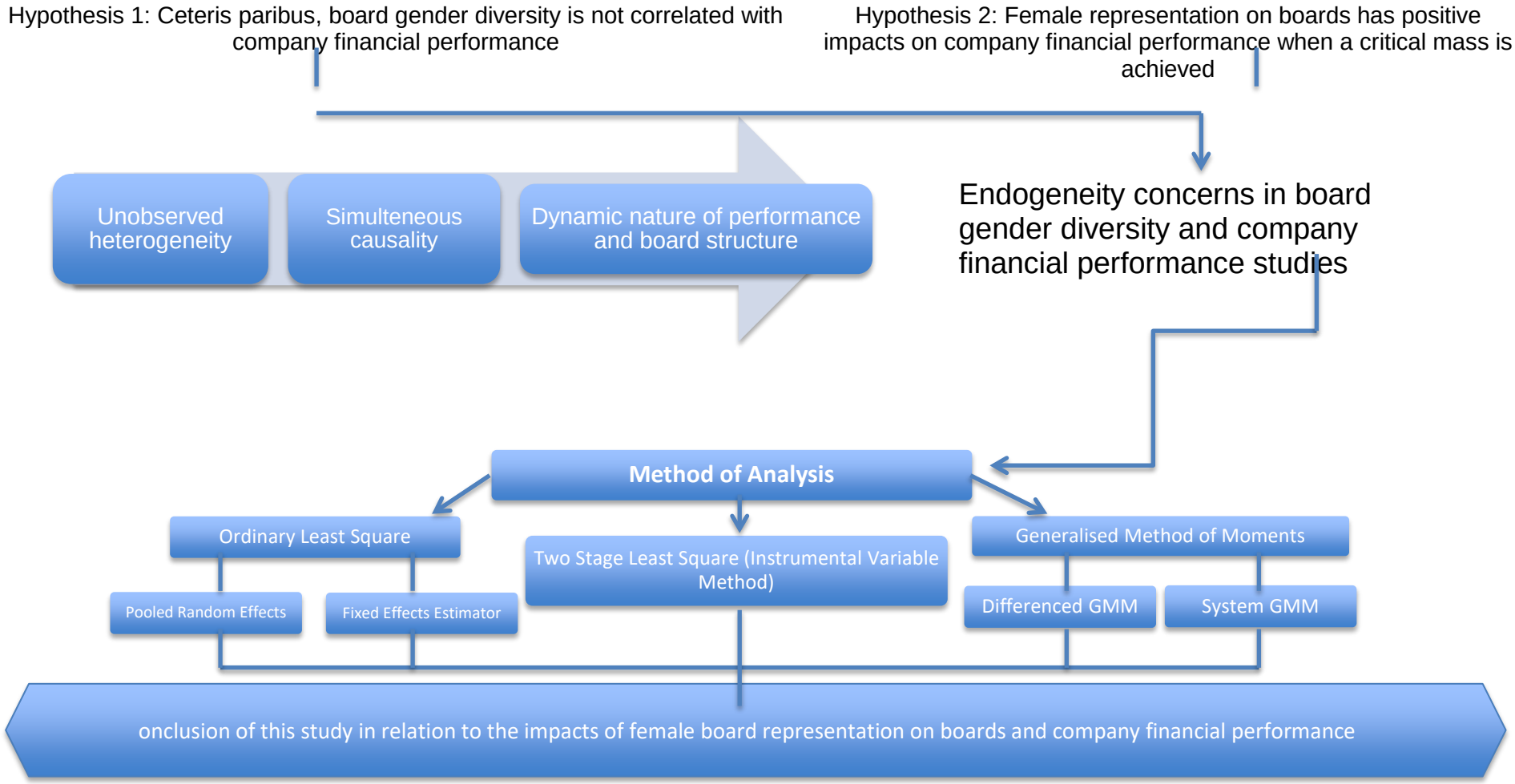
t – The time period of each financial year

k – The number of control variables used in the structural model

This study runs the regression analysis of each critical mass grouping by applying all statistical methods mentioned in section 3.5.2.3 based on the critical mass model specification (7). We then compare the performance measures based on critical mass classification, using pooled OLS estimation, fixed and random effects model, 2SLS with the instrumental variable method, dynamic

differenced GMM and system GMM estimations, to analyse the link between these gender diversity groups and company financial performance.

Figure 3.1: Research Design and Methodology



3.7 Chapter Summary

This chapter has presented the methodological frameworks, models and empirical measures to examine the primary focus of this study, the relationship between board gender diversity and company performance. Figure 3.1 present the research design and the methodology of this study. The discussions on the endogeneity concern in board gender diversity and company financial performance demonstrate that researchers need to carefully address all three forms of endogeneity that arise from unobserved company-level heterogeneity, simultaneity and dynamic nature of the variables. This study applies various econometric techniques to examine the hypotheses of this study and demonstrate how these endogeneity concerns can be observed in each of the testing procedures. The discussions of the econometric techniques reveal that although fixed effects estimation is able to account for unobserved heterogeneity at the company level, the strict exogeneity assumptions in OLS estimations produce biased and unreliable inference in examining the relationship between board gender diversity and company performance. While the external instrumental variable in 2SLS estimation is able to strip off the endogenous relationship between board gender diversity and company performance, this method is unable to control for the possibility of a dynamic relationship of past performance on the board structure. Dynamic GMM estimations, both the differenced, and system GMM methods, are robust to all forms of endogeneity. With the implementation of the exogenous external instrumental variable in the dynamic GMM model, this study expects to produce reliable and consistent estimates. This chapter emphasises that failing to address the endogeneity problems may lead to biased and unreliable inferences that suggest a spurious correlation between board gender diversity and company performance. The following chapter presents the analysis and results using these various econometric techniques and how the endogeneity issue can be observed with the estimates.

Chapter 4: Results

4.1 Introduction

This chapter presents the multiple regression results, findings and discussions of this study. This chapter begins with descriptive statistics of the entire sample data, the yearly changes of female board representation over the years and the critical mass grouping of females on boards. This is followed by a correlation matrix of this study's variables. The results of the diagnostic tests are presented and their implications are discussed before the detailed regression analysis. We employ both the entire period analysis and critical mass grouping analysis and present extensive comparative results based on pooled OLS random and fixed effects analysis, 2SLS instrumental variable analysis and the dynamic GMM methods. This is followed by a discussion of the main findings between the gender-diverse boards and company performance. We conclude this chapter with a chapter summary and conclusions of the analysis.

4.2 Descriptive Statistics

This section presents detail information on the sample data, the summary descriptive statistics, the detailed breakdown of female board representation by year and the correlation of the variables in this study.

4.2.1 The Sample Data

The sample consists of the top 200 non-financial companies listed on the ASX for the period from 2008 to 2015. The final sample of unbalance data consists of 299 companies for the period from 2008 to 2015 with 1981 firm-years.

4.2.2 Summary Statistics

Table 4.1 presents the summary statistics for the sample data, the dependent variable, variable of interest, board and company level control variables[20]. This study includes all sample data without removing the outliers as the extreme values are legitimate data of this study and it is the nature of the sample data that is not caused by incorrect data entry or measurement error. Eliminating the outliers will cause the loss of the important observations that can be important to the analysis[21]. This study also performs log transformation on Tobin's Q, market capitalisation and total revenue to reduce the influence of the outliers and extremely large values to give the model a cleaner distribution.

The dependent variable, Tobin's Q, reflects market expectations of a company's future earnings (Montgomery & Wernerfelt, 1988) . The ratio of Tobin's Q provides a yardstick of companies' competitive advantage and performance. In general, a ratio of more than one reflects investors are expecting a positive return as the result of effective utilisation of the existing assets. On the other hand, a ratio of less than one reflects the under utilisation of the company's existing resources. Based on the descriptive statistics on Table 4.1, the mean (median) of Tobin's Q of 2.08 (1.31) indicates that the majority companies in this sample are utilising the company's resources effectively and generating a positive return to the investors. Despite the median value of 1.31 (which is lower than the mean value), the further breakdown of the detailed Tobin's Q (not shown in Table 4.1) reveals that 28.5% of the sample data of this study has a value of Tobin's Q of less than one, indicating that these companies are under-utilising the company's existing resources with majority observations of the sample data are generating positive return to the investors.

[20] Refer *to table 3.5 in chapter 3* of this study for variable descriptions.

[21] Note: To ensure that the extreme value in the dataset does not have any impact on the overall results, this study has performed a comparison of regression analysis based on 1% winsorising of the dataset. Appendix 12 presents the comparison results and shows no major differences between the two sets of data.

Table 4.1 – Summary Descriptive Statistics based on Pooled Data

Variable	Observations	Mean	Median	S.Dev	Min	Max
Dependent Variable						
Tobin's Q	1981	2.08	1.31	7.07	0.06	255.6
Log of Tobin's Q (LogQ)	1981	0.17	0.12	0.28	-1.2	2.41
Variable of Interest						
Number of Females on Boards (FOB)	1981	0.86	1	0.93	0	5
Proportion of Females on Boards (PFOB) - %	1981	10.78	11.11	11.36	0	57.14
The presence of Females on Boards (DFOB)	1981	0.57	1	0.5	0	1
Blau Index (Blau)	1981	0.17	0.20	0.16	0	0.5
Company Level Control Variables						
Market Capitalisation ($Millions)	1981	4,480	1,067	16,000	2.283	244,000
Log of Market Capitalisation (LogMC)	1981	9.03	9.03	0.72	6.36	11.39
Log Revenue (LogRev)	1981	8.56	8.79	1.37	0	10.92
Gearing Ratio (NDE) - %	1981	30.46	26.03	150	-2,780	2,279
Risk Measure (VROE) - %	1981	11.68	4.05	26.86	0	425.77
Board Level Control Variables						
Board Size (Board) - Number	1981	7.42	7	2.29	3	19
Proportion of Independent Directors (PIndDir) - %	1981	65.34	66.67	18.31	0.25	100
CEO Tenure (CEOT) – Number of year	1981	5.92	5	3.85	0	23
Duality of Chairman and CEO (CEODuo)	1981	0.07	0	0.25	0	1
External Instrumental Variable						
Proportion of local female councillors (FC) - %	1981	42.72	40	16.1	6.67	75

Note to table 4.1:
The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. Tobin's Q is the dependent variables of this study. It measures the market performance and is calculated from the ratio of the sum of the company's market value of equity and book value of debt to its book value of assets. The variable of interest of this study is the proportion of female directors on board (PFOB). The presence of female directors on boards (DFOB) and Blau index (Blau) are the variables of interest for the robustness tests of the study. The definitions and details of other control variables can be referred to Table 3.5 in chapter 3 of this study.

The variable of interest of this is study is the proportion of female directors on boards (PFOB), measured by the total number of female directors over the total number of board members. The mean (median) of the proportion of female directors on boards (PFOB) for the sample is 10.78% (11.11%). Approximately half of the sample data has the proportion of female directors less than the mean value. This is supported by the statistics of the number of female directors on boards (FOB) with the mean of 0.86 and majority of the companies has only one female director on boards (median value = 1) on the overall data. This study also includes both the presence of female directors on boards (DFOB) and Blau index

(Blau)[22] in the robustness test of board gender diversity. DFOB is a dummy variable that equals one when there is at least one female director present on the company board of directors or zero if the company has no female directors on the board. The data shows that only 57% of the sample data have female directors on boards. This equates to 43% of the sample companies or 861 firm-years that have no female representation on their board.

To further elaborate on the variable of interest of this study, Table 4.2 presents the details summary statistics of the female board representation based on annual data. As indicated in the summary statistics in Table 4.1, the average proportion of female director on boards for the pooled data is 10.78% between 2008 and 2015. However, the yearly statistics (refer table 4.2) show that the average proportion of female directors on boards was below 10% before the introduction of gender diversity requirement by The Australian Stock Exchange Corporate Governance Council in 2010. There are only 5.81% of female directors on boards in 2008, 5.93% in 2009 and 7.46% in 2010. The proportion of female board representation only increased to 18.7% in 2015, representing 2.2-fold increment in 7 years since 2008.

Table 4.2: Descriptive Statistics of the Proportion of Female Directors on Boards (Annual statistics 2008 to 2015)

Year	Observations	Mean	Std Dev	Min	Max
2008	265	5.81	8.23	0	33.33
2009	261	5.93	8.9	0	50
2010	261	7.46	9.97	0	55.56
2011	254	9.66	10.46	0	55.56
2012	240	11.7	10.57	0	57.14
2013	236	13.21	10.92	0	50
2014	236	15.57	11.84	0	50
2015	228	18.67	13.05	0	50

Note to table 4.2:
The sample consists of the break down of an unbalanced panel data of 299 companies by year with 1981 firm-year observations for the period from 2008 to 2015. The descriptive statistics show the proportion of female directors on board (the variable of interest of this study), which is calculated by the total number of female directors over the total number of board members.

[22] Blau index measures diversity with the following formula (refer section 3.5.2.2 for description detail):

$$B = \sum_{c=1}^{k} 1 - [S^2 + (1 - S^2)]$$; Where S is the proportion of female directors

Table 4.1 also presents the descriptive statistics for the control variable. The company level control variables comprise company size, measured by company's market capitalisation (LogMC) and total revenue (LogRev), gearing ratio measured by the ratio of debt to equity (NDE) and company's risk factor measured by volatility of ROE (VROE). Market capitalisation is the number of common shares outstanding multiplied by the share price at the end of financial year. The summary statistics show that the average market capitalisation of the sample in this study is $4.48 billion, with the lowest market capitalisation of $2.28 million and the highest market capitalisation of $244 billion. Total revenue is obtained from the company's financial statement, which is the total sale of the companies for the financial year. Both market capitalisation and total revenue statistics indicate that the sample data of this study covers a wide range of companies in the ASX200 from the small capitalisation companies to the multi-billion companies. The company's gearing ratio is measured by the company's total debt net cash over the shareholder's equity (NDE). Highly geared companies required greater monitoring costs and affect company financial performance negatively (Adams & Ferreira, 2009; Schultz et al., 2010; Wang & Cliff, 2009). The average gearing ratio of the sample in this study is 30.46, indicating that the average gearing ratio of the sample is about 30% with some of the companies being highly geared at 22 times their equity value. VROE represents the volatility of the risk factor of a company and it is measured by the standard deviation of the pervious three years equity returns. The mean of the sample data's volatility of risk factor is 11.68 with a median of 4.05.

The board level control variables comprise board size (Board), the board's independent ratio (PIndDir), CEO tenure (CEOT) and the duality of a joint function of CEO and chairman (CEODua). The average board size comprises 7.42 directors, and the majority (on average of 65%) of the board members are independent directors. The average tenure for the CEOs serving on the company boards is approximately six years and less than 5% of the sample data has CEO with a joint function as the chairman of the boards. The median values of the

board level control variables are relatively close to the mean values, indicating that the central tendency of the board control variables are distributed at the mid point.

This study also applies the external instrumental variable method to address the endogeneity issue in the model. We use both the influence of political science in corporate governance (Terjesen et al., 2015) and the theory of "economic ramification of distance" (Bouwman, 2012) in developing the external instrumental variable of this study, the proportion of local female councillors (FC). We believe that the institutional environment co-evolves with gender policies and the concept of geographical influence of local female councillors is related to the number of experienced female executives excelling at the board level. The summary statistics show that the average proportion of local female councillors of the sample is about 43%. The minimum proportion of female councillors on councillor's boards is 7% and a maximum of 75% in the sample data.

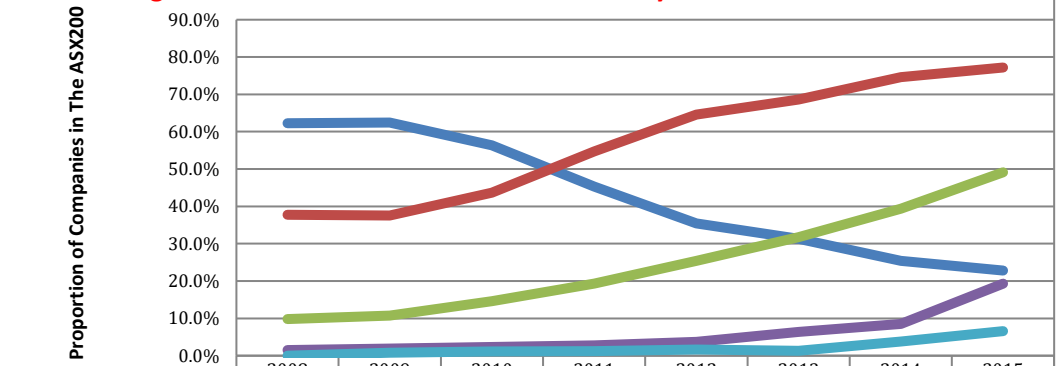
In addition to the pooled data, this study further breaks down the sample data with Kanter's (1977b) critical mass classifications[23]. Table 4.3 presents the summary statistics of the sample based on two different critical mass classifications for this study by year. The summary shows that female board representation has increased in general over the years from 2008 to 2015, even though majority of the boards have no female representation, which is 43% or 861 firm-year observations have no female directors on boards. Figure 4.1 presents the boardroom gender diversity over the years of this study. We notice that boards comprising at least 20% female directors have increased steadily from less than 10% of total sample boards in 2008 to more than 49% over sample boards in 2015. However, boards with at least 30% and 40% female directors have only marginally increased over the same period.

[23] The four gender groupings according to Kanter's classification are: (i) K1 (uniform group) – boards consist of all male directors; (ii) K2 (skewed group) – boards with at least one but less than twenty percentage of female directors; (iii) K3 (tilted group) - boards with at least twenty percentage but less than forty percentage of female directors; and (iv) K4 (balanced group) – boards with at least than forty percentage of female directors. The modified critical mass classifications are: (i) ACM0 – boards consist of all male directors; (ii) ACM20 – boards with at least twenty percentage of female directors; (iii) ACM30 – boards consist of at least thirty percentage of female directors; and (iv) ACM40 – boards with at least forty percentage of female directors.

Table 4.3: Summary Statistics of Female Board Representation based on Critical Mass Groupings
(Number of boards with female board representation based on critical mass groupings)

	2008-2015	2008	2009	2010	2011	2012	2013	2014	2015
K1 - 0% PFOB	861	165	163	147	115	85	74	60	52
K2 - 0< PFOB <20%	638	74	70	76	90	94	87	83	64
K3 - 20%<= PFOB <40%	443	26	26	35	46	57	72	84	97
K4 - >=40% PFOB	39	0	2	3	3	4	3	9	15
ACM0 - 0 PFOB	861	165	163	147	115	85	74	60	52
ACM20 - At least 20% of FOB	482	26	28	38	49	61	75	93	112
ACM30 - At least 30% of FOB	110	4	5	6	7	9	15	20	44
ACM40 - At least 40% of FOB	39	0	2	3	3	4	3	9	15

Figure 4.1: The ASX200 Boardroom Diversity Over 2008 to 2015



	2008	2009	2010	2011	2012	2013	2014	2015
0 PFOB (ACM0)	62.3%	62.5%	56.3%	45.3%	35.4%	31.4%	25.4%	22.8%
Presence of FOB	37.7%	37.5%	43.7%	54.7%	64.6%	68.6%	74.6%	77.2%
At least 20% of FOB	9.8%	10.7%	14.6%	19.3%	25.4%	31.8%	39.4%	49.1%
At least 30% of FOB	1.5%	1.9%	2.3%	2.8%	3.8%	6.4%	8.5%	19.3%
At least 40% of FOB	0.0%	0.8%	1.1%	1.2%	1.7%	1.3%	3.8%	6.6%

Note to table 4.3 and figure 4.1:
The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The critical mass groupings are based on two different classifications. Based on Kanter's critical mass gender classification, K1 represents the uniform group, boards with no female directors on boards, K2 represents the skewed group of firm-year observations with at least one female director on boards but not exceeding 20% of female directors; K3 represents the tilted group of firm-year observations with at least 20% but not exceeding 40% of female directors. K4 represents the balanced group of firm-year observations with at least 40% of female directors. The groupings with the abbreviations of ACM represent the modified gender grouping based on firm-year observations with a minimum of proportion females in an incremental order. ACM0 represents the group of firm-year observations with no female directors on boards, while ACM20, ACM30, and ACM40 represent the group of firm-year observations with at least 20%, 30% and 40% of female directors on boards respectively.

Table 4.4 presents the detailed break down of female board representation based on the absolute number of pooled and annual data. There are 62% of the companies in the sample data with no female directors on the company's board in 2008 and 2009 compared to only 25% and 20% of companies in 2014 and 2015 respectively. Although the proportion of companies that appoint three or more female board members has increased from 2% in 2008 to 23% in 2015, representing a 10.5-fold increment of companies with three or more female directors on board, only 5% of the firm-year observations in the pooled data have three or more female directors on boards.

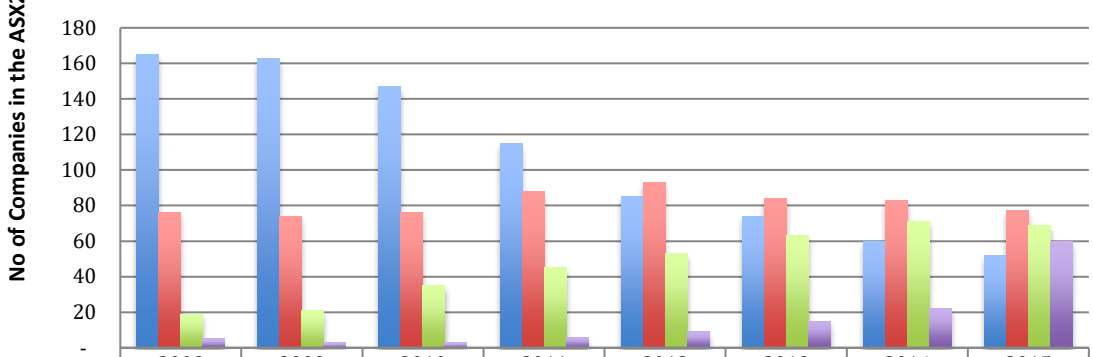
Table 4.4: The Number of Boards with the Absolute Number of Female Board Representation on The ASX200 Boards (Pooled and Annual Data)

Year	0 FOB		1 FOB		2 FOB		>=3 FOB	
	No of Boards	%	No of Boards	%	No of Boards	%	No of Boards	%
2008-2015	861	43%	651	33%	376	19%	93	5%
2008	165	62%	76	29%	19	7%	5	2%
2009	163	62%	74	28%	21	8%	3	1%
2010	147	56%	76	29%	35	13%	3	1%
2011	115	45%	88	35%	45	18%	6	2%
2012	85	35%	93	39%	53	22%	9	4%
2013	74	31%	84	36%	63	27%	15	6%
2014	60	25%	83	35%	71	30%	22	9%
2015	52	20%	77	30%	69	27%	60	23%

Note to Table 4.4:
Table 4.4 presents the detailed breakdown of the number and the proportion of firm-year observation in relation to the absolute number of female on boards. 0 FOB refers to the boards with all male directors, no female director was appointed to the board of directors. 1 FOB refers to the boards with one female director on the board. 2 FOB refers to boards with two female directors and 3 FOB refers to boards with at least three female directors. Each row refers to the respective years of observation with the number and proportion of companies for each category of absolute female board representation.

Figure 4.2 charts female board representation based on absolute numbers. Boards with at least three female directors have increased more than 10-fold by 2015 since 2008. The progression has been slow up until 2014 to 2015 where a dramatic increase is shown.

Figure 4.2: Number of Companies in the ASX200 based on the Absolute Number of Female Directors on boards



	2008	2009	2010	2011	2012	2013	2014	2015
0 FOB	165	163	147	115	85	74	60	52
1 FOB	76	74	76	88	93	84	83	77
2 FOB	19	21	35	45	53	63	71	69
>=3 FOB	5	3	3	6	9	15	22	60

Note to Figure 4.2:
Figure 4.2 presents the number of companies with the respective number of female directors sitting on the board of directors. 0 FOB refers to boards with no female directors. 1 FOB refers to boards with one female director. 2 FOB refers to boards with two female directors and 3 FOB refers to boards with at least three female directors.

Figure 4.2 and Table 4.4 show that the average number of boards with one female director over the sample period is 33%. This percent is consistent throughout the study period, ranging between 28% and 39%. Boards with two female directors have increased steadily between 2008 and 2015, with a slight reduction in 2015. Contrary, boards with all male directors have declined significantly from 62% in 2008 to 20% in 2015, a decline of more than 3-fold in seven years. While on the other hand, boards with three or more female directors have increased at a rapid rate particularly in 2015, where 23% of the boards have three of more female directors compared to 9% in 2014.

4.2.3 Correlation Matrix

Table 4.5 presents the correlation matrix between all the variables in this study.

Table 4.5: Correlation Covariance

	LogQ	PFOB	Blau	Board	PIndDir	CEOT	CEODua	LogMC	LogRev	NDE	VROE	FC
LogQ	1											
PFOB	-0.073*	1										
Blau	-0.077*	0.980*	1									
Board	-0.120*	0.249*	0.294*	1								
PIndDir	-0.171*	0.270*	0.275*	-0.027	1							
CEOT	0.136*	-0.108*	-0.096*	0.027	-0.082*	1						
CEODua	0.058*	-0.113*	-0.118*	0.0180	-0.165*	0.142*	1					
LogMC	0.160*	0.352*	0.385*	0.582*	0.202*	0.080*	-0.055*	1				
LogRev	-0.202*	0.293*	0.323*	0.469*	0.222*	0.106*	-0.094*	0.595*	1			
NDE	-0.144*	0.115*	0.118*	0.089*	0.105*	-0.021	-0.033	0.119*	0.145*	1		
VROE	0.248*	-0.120*	-0.122*	-0.11*	-0.046*	-0.05*	0.025	-0.212*	-0.184*	-0.15*	1	
FC	-0.056*	0.140*	0.130*	-0.033	0.019	-0.040	-0.050*	-0.003	-0.054*	-0.006	0.0207	1

Note to Table 4.5:
Table 4.5 presents the correlation matrix between all the selected variables of this study based on the unbalanced panel data of 1981 firm-year observation from 2008-2015. LogQ refers to the performance measure, the dependent variable of this study. Board gender diversity is represented by the proportion of female directors (PFOB), and the Blau index (Blau) as the alternate measure for the robustness test. The board level control variables comprise board size (Board), the proportion of independent directors (PIndDir), CEO's tenure (CEOT) and the duality function of the chairman and the CEO (CEODua). The company level control variables comprise the log of market capitalisation (LogMC), total revenue (LogRev), company's gearing ratio (NDE) and company's volatility (VROE). The proportion of local female councillors (FC) is the selected external instrumental variable of this study. The asterisk represents the pairwise statistical significance between the two variables at the critical value of 5% (*).

The purpose of this correlation analysis is to understand the relationship between the selected variables in this study. The Pearson's pairwise correlation matrix in Table 4.5 indicates that the explanatory variables and control variables of this study are significantly correlated at the 5% significant level with the dependent variable, Tobin's Q (LogQ). If the correlation between two variables is 0.7 or more, there is a high probability a multicollinearity problem exists between the two variables (Brooks, 2009). The matrix above shows that the correlation between PFOB and Blau index is 0.98, indicating that these two variables are highly correlated. These two variables however are substitute and are not specified simultaneously in a regression model. PFOB serves as the variable of interest of this study and the Blau index serves as an alternate measure in the robustness test of the board gender diversity. The correlation matrix suggests that there is no concern of multicollinearity in the remainder of the variables in the sample. In line with expectations there is a positive

correlation between the endogenous explanatory variable, the proportion of female directors on boards (PFOB), and the external instrumental variable in this study, the proportion of local female councillors (FC). The positive and significant correlation indicates that the representation of local female councillors has a positive impact on the female board representation, confirming that it is a good external instrumental variable.

4.3 Diagnostic Tests

This section presents the diagnostic tests for our sample data before the hypothesis testing. This study conducted multicollinearity, heteroskedasticity, unit roots, endogeneity and Hausman tests to ensure that dataset are free from biases before proceeding with the statistical analysis.

4.3.1 Multicollinearity Test

This study tests for multicollinearity among all the variables to avoid spurious results. As shown in Table 4.5, the correlations between all the variables are less than 0.7, except for the proportion of female directors on boards (PFOB) and the Blaus Index (Blau). This is because these two variables represent the same measure, which is the board gender diversity measure. The correlation matrix results reveal that the correlation between all other variables is less than 0.7. Therefore, there is no issue of multicollinearity among the variables.

4.3.2 Heteroskedasticity Test

We employ Breusch-Pagan Lagrange Multiplier to test for heteroskedasticity issue in the panel data (Baltagi, 2008) . To test if heteroskedasticity is present in the sample data, we hypothesise that the following null hypothesis:

H_0: The variance in the model is constant, that is homoskedasticity

Table 4.6: The output of Heteroskedasticity Test

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: PFOB LogMC LogRev NDE VROE Board PIndDir CEOT CEODua
chi2(9) = 797.21
Prob > chi2 = 0.0000

Table 4.6 presents the heteroskedasticity test with a significant chi-square of zero, indicating the variance in the dataset is non-constant and heteroskedasticity is present in the dataset. The presence of heteroskedasticity in the dataset suggests that dynamic GMM estimation is the appropriate method of analysis.

4.3.3 Hausman Test On Fixed Effects Versus Random Effects

The Hausman Test determines whether the difference in the coefficients is systematic. A fixed effects model is appropriate when the estimation makes inferences on the outcomes of a sample data, while random effects model is more appropriate when the estimates of a model make unconditional inferences of a population. The fixed effects model of this study is as follows:

$$P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \delta_i + \gamma_t + \varepsilon_{it} \qquad t = 1\ldots\ldots t,\ i = 1\ldots\ldots n \quad \text{---------- (1a)}$$

Where:

- P – The n*1 vector of company financial performance, measured by Tobin's Q, across n observations
- GD – The time-invariant n*1 matrix of gender diversity measure across N observations
- CV – The time-invariant n*k matrix of the control variables across n observations
- β – The unknown k*1 vector of regression parameters
- δ – Company time-invariant fixed effects
- γ – Year dummy fixed effects
- ε – A n*1 vector of the error term

i – The number of n observations of the sample

t – The time period of each financial year

k – The number of control variables used in the structural model

δ_i and γ_t above represent the company and time-specific effects. Hausman specification test examines if the company and time specific effects α_i and γ_t can be treated as random effects that are drawn from a population or fixed effects that are drawn from a sample. The null hypothesis in the Hausman specification test is:

H_0: There is no correlation between δ_i and γ_t with $\varepsilon_{it,}$ indicating that random effect is more appropriate.

Table 4.7 the Chi-square tests is significant at the 1% level, suggesting that fixed effects model is the appropriate estimation for analysis.

Table 4.7: Hausman Test on Random Effects Vs Fixed Effects

	(b) FE	(B) RE	(b-B) Difference	S.E.
GD	-0.0016	-0.0017	0.0001	0.0002
Board	-0.0212	-0.0291	0.0078	0.0013
PIndDir	-0.0018	-0.0022	0.0004	0.0001
CEOT	-0.0035	0.0009	-0.0044	0.0006
CEODua	-0.0636	-0.0420	-0.0217	0.0098
LogMC	0.3530	0.3115	0.0415	0.0049
LogRev	-0.0742	-0.0763	0.0021	0.0019
NDE	0.0000	0.0000	0.0000	0.0000
VROE	0.0021	0.0022	-0.0001	0.0000

b = consistent under Ho and Ha

B = inconsistent under Ha, efficient under Ho

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)

chi2(9) = 173.27

Prob>chi2 = 0.0000

4.3.4 Endogeneity Test

Hausman's specification test in Section 4.3.3 indicates that fixed effects estimator is more appropriate than random effects estimator in examining the relationships between gender diversity and company financial performance in this study. The fixed effects method with OLS model is appropriate under the assumptions that the explanatory variables are strictly orthogonal to the errors terms, and the dependent variables are a function of the exogenous explanatory variables. Sila et al. (2016) suggests that fixed effects estimator is insufficient to address the possibility of endogeneity that exists in a diversity-performance study if the explanatory variables are not exogenous to the dependent variable.

The correlation matrix in Table 4.5 reveals that there is a link between the gender diversity measures, the proportion of female directors (PFOB) and the Blau index (Blau), to the company level characteristics. There are various possibilities that link the board gender diversity to company characteristics. For example, unobserved characteristics such as preferences of companies to have gender-diverse boards; large companies tend to have a higher gender diversity ratio on the board of directors. In some circumstances, some companies tend to maintain a good corporate governance image or corporate culture by employing more female directors. Another possible link between board gender diversity and performance is the simultaneous causality between female board representation and performance due to self-selection process. To ensure that this study estimates the relationship between the gender-diverse boards and company financial performance without bias estimates, this study controls for the most damaging endogeneity bias in the estimates by using Durbin-Wu-Hausman test of endogeneity. The test is whether the variable of interest of this study, the gender diversity measure, is endogenously determined with company performance. The null hypothesis for the endogeneity test is as follows:

H_0: The explanatory variables are exogenous.
H_1: The explanatory variables are endogenous.

We first run the two-stage-least-square instrumental variable analysis on the identified problematic explanatory variable (PFOB) with the specified external instrumental variable (FC) and all other control variables in the model. We then verify if endogeneity issue is a concern in the model using Durbin-Wu-Hausman's endogeneity test. Table 4.8 presents the summary results of the endogeneity test.

Table 4.8: Results of Endogeneity Test:

Tests of endogeneity	
Ho: variables are exogenous	
Durbin (score) chi2(1)	= 18.7739 (p = 0.0000)
Wu-Hausman F(1,1970)	= 18.8482 (p = 0.0000)

The F-test of Durbin-Wu-Hausman's endogeneity test in Table 4.8 indicates that the endogeneity issue exists in the model at a highly significant level, where the F-test chi-square is zero, rejecting the null hypothesis of exogeneity of the variable. This confirms that ordinary least square method using random effects or fixed effects is inefficient to explain the relationship between board gender diversity and company performance. The results from the OLS estimations can be a bias inference if the endogeneity issue is not dealt with. This indicates that the variable of interest of this study, the proportion of female director on boards (PFOB), is endogenously determined with the company performance. In this instance, there is a possibility of confounding factors between the proportion of female directors on boards and company performance, which results in bias estimators if the analysis is based on the OLS estimation.

4.3.5 Tests On Selection Of External Instrumental Variable

The discussion in section 4.3.4 suggests that the endogeneity concern is an issue in examining the relationship between the dependent variable and the explanatory variable in this study. The general consensus suggests that a better strategy in dealing with the endogeneity issue is by way of identifying a truly exogenous external instrumental variable. A valid external instrumental variable needs to fulfil two conditions: first: the external instrumental variable must be correlated with the

endogenous explanatory variable, second: the external instrumental variable must be exogenous and uncorrelated with the error terms in the model. However, many studies recognise that identifying a truly exogenous external instrumental variable is a challenging task (Bozec, 2012).

This study introduces the proportion of local female councillors as the external instrumental variable in this study. We use both the influence of political science in corporate governance (Terjesen et al., 2015) and the theory of "economic ramification of distance" (Bouwman, 2012) . We believe that the institutional environment co-evolves with gender policies and the concept of geographical influence of local female councillors on the number of experienced female executives to excel at the board level. In this instance, the external instrumental variable can capture the effects on company financial performance on changes in the proportion of female directors on boards by eliminating the confounding effects between gender diversity and company performance.

For the instrumental variable to be valid, there are two requirements, the relevancy and the exogeneity verification. To verify the relevancy of the external instrumental variable, we test the association between the proportion of female directors and the proportion of local female councillors by referring to the first stage regression results in 2SLS estimation and the F-test of the first stage regression. To fulfil the second requirement in applying an external instrumental variable, which is the exogeneity of the external instrumental variable with the dependent variable in the model, we refer to both the economic theory and Hansen J-test in dynamic GMM method.

To test the relevancy of the external instrumental variable, we examine the covariance between the proportion of local female councillors (FC) and the proportion of female directors on boards (PFOB), Cov (FC, PFOB) $\neq$ 0. The null hypothesis to examine the relevancy of the external instrumental variable is:

H_0: There is no correlation between the proportion of local female councillors (FC) and the proportion of female directors on boards (PFOB)

The hypothesis to verify the exogeneity between the proportion of local female councillors (FC) and the error terms or Tobin's Q in this study is to test if the covariance between the proportion of local female councillors and the error terms equal to zero, Cov (FC, ε) = 0. With pooled OLS method, if the Durbin-Wu-Hausman's endogeneity specification test indicates that the endogeneity problem does exist in the structural model of this study, it means that the OLS estimator of ε is biased. In this study, we are unable to test if Cov (FC, ε) = 0 because we do not have an unbiased estimator for ε. With the presence of endogeneity in the structural model, we apply dynamic GMM method to estimate the relationship between board gender diversity and company performance. Dynamic GMM allows us to verify the second condition of the external instrumental variable by referring to Hansen J-test of exogeneity of an instrument (Gippel et al., 2015). The null hypothesis to examine the exogeneity of the external instrumental variable is:

H_0: The external instrument is exogenous

The details analysis of the first stage regression results in 2SLS is presented in Appendix 11. The results indicate that the selected external instrumental variable, the proportion of local female councillors (FC) is significant and positively correlated to the proportion of female directors (PFOB). The t-statistics in the first stage regression shows a strong and significant positive correlation between the proportion of local female councillors and the proportion of female directors at a significance level of 1%.

Table 4.9: First-stage regression summary statistics

Variable	*R-Sq.*	*Adjusted R-Sq*	*Partial R-Sq.*	*F(1,1971)*	*Prob > F*
PFOB	*0.2168*	*0.2133*	*0.0240*	*48.4932*	*0.0000*

Table 4.9 presents the results of F-test on the first stage regression summary statistics. The F-test estimation rejects the null hypothesis, indicates that the selected external instrumental variable in this model, the proportion of local female councillors (FC), is not a weak instrument in this analysis and is positively correlated to the endogenous variable, the proportion of female director on boards (PFOB). The results indicate that the relationship between these two variables is significant at the 1% level, suggesting that the proportion local female councillors (FC) is relevant and positively correlated with the proportion of female directors (PFOB). This confirms the relevancy test of applying the external instrumental variable method and supports our argument on the influence of political science in corporate governance, where local female councillors play an important role in influencing other females' involvement in the workforce at the executive and board level.

The F-test of the Durbin-Wu-Hausman's endogeneity specification test in Table 4.8 indicates that the endogeneity issue exists in the model at a highly significant level. This suggests that the OLS estimator of ε is biased and we are unable to test if Cov (FC, ε) = 0 because we do not have an unbiased estimator for ε. Using economic theory, we assume that the proportion of local female councillors (FC) has no correlation with company performance. However, to be statistically convincing to verify the exogeneity of the proportion of local female councillors to the company performance, we apply Hansen J-test of exogeneity of an instrument with the dynamic GMM method. Section (a) of Table 4.10 presents Hansen J-test of exogeneity of the instrument from the dynamic differenced GMM method while section (b) of Table 4.10 presents the Hansen J-test of exogeneity of the instrument from dynamic system GMM method. The results show a probability chi-square of 0.545 and 0.618. In both instances, the results are not significant, and we do not reject the null hypothesis. This suggests that the instruments used in the estimation are exogenous and there is no correlation between the proportion of local female councillors (FC) and the error terms in the model.

Table 4.10 (a): Hansen J-Test of exogeneity of instruments – Differenced GMM

Difference-in-Hansen tests of exogeneity of instrument subsets:
iv(FC)
Hansen test excluding group: chi2(2) = 0.35 Prob > chi2 = 0.838
Difference (null H = exogenous): chi2(1) = 0.67 Prob > chi2 = 0.412

Table 4.10 (b): Hansen J-Test of exogeneity of instruments – System GMM

GMM instruments for levels
Hansen test excluding group: chi2(3) = 2.20 Prob > chi2 = 0.532
Difference (null H = exogenous): chi2(12) = 13.06 Prob > chi2 = 0.365
iv(FC)
Hansen test excluding group: chi2(14) = 13.91 Prob > chi2 = 0.457
Difference (null H = exogenous): chi2(5) = 1.34 Prob > chi2 = 0.246

4.4 Regression Analysis And Results – Gender-Diverse Boards And Company financial performance

This sub-section presents the regression results of this study between boards gender diversity and company performance. We first apply various statistical regression methods as employed by previous empirical studies to examine the relationship between the gender-diverse boards and company performance. We then illustrate the implications of implementing inappropriate econometrics methods that cause the spurious correlations between the variables. The dataset comprises unbalanced panel data of 1981 firm-year observations of 299 companies listed in the ASX200 over the period from 2008 to 2015. The regression analysis begins with pooled ordinary-least-square method (OLS) using both fixed and random effects. This follows by the analysis using two-stage-least-square (2SLS) instrumental variable method and dynamic Generalised Method of Moments (GMM). The results for each of these methods are discussed in the following section.

4.4.1 Ordinary Least Square (OLS) Method- Random Effects and Fixed Effects Estimation

Early literature in governance and performance studies commonly uses pooled OLS method, with either fixed or random effects estimation. This section present pooled OLS estimation as the baseline approach to compare the regression

results using different econometrics technique. In the pooled OLS method, Breusch and Pagan-Lagrange Multiplier test as discussed in section 4.3.2 indicates that the variance in the dataset is non-constant. The results present a probability chi-square of zero, rejecting the null hypothesis that the variances are constant. With the presence of heteroskedasticity, we perform standard errors robustness test in the estimation to examine the relationship between board gender diverse boards and company financial performance. Contrary, the Hausman test in section 4.3.3 rejects the random effects estimation with a significant F-test at the 5% level, indicating that fixed effects estimation is more appropriate to correct for any unobserved heterogeneity existing in diversity-performance studies.

Table 4.11 presents the OLS regression results. The random effects and fixed effects estimations report a consistent relationship between board gender diversity (GD) and company financial performance (LogQ). The results suggest that the proportion of female directors (PFOB) is highly significant and negatively correlated with company performance, Tobin's Q (LogQ), at the 1% level. The robustness test of the gender diversity (GD) measure, the Blau index (Blau), yields consistent results as the variable of interest, the proportion of female directors (PFOB), with a highly significant and negatively correlation at the 1% level.

In relation to the control variables, at board level, both board size (Board) and proportion of independent directors (PIndDir) show significant negative correlations with company performance, indicating that larger board size has a negative impact on the company performance. Similarly, the proportion of independent directors also has a negative impact on the company performance. CEO tenure (CEOT) and CEO duality (CEODua) do not have any correlation with Tobin's Q for both random and fixed effects estimation. At the company level, the control variable market capitalisation (LogMC) and volatility measured by the standard deviation of return on equity (VROE) have significant and positive correlations with company financial performance at the 1% level. On the other

hand, total revenue (LogRev) has negative correlations with Tobin's Q while gearing ratio (NDE) of the companies has no significant on company performance.

We acknowledge that if the relationship between gender-diverse boards and company financial performance is due to other reasons or only in part of the proportion of female directors (PFOB), then the endogeneity issue does arise. In this case, the coefficient of PFOB cannot be interpreted in the simple correlation manner using OLS method. This is because the coefficient of PFOB has no meaning in explaining the company financial performance and the magnitude of the relationship, as well as the direction of the relationship, can be misinterpreted. We will discuss the key findings and main results in the later section.

Table 4.11: OLS Regression Analysis Between Board Gender Diversity and Company Financial Performance

Explanatory Variables	Dependent Variable - Log Q			
	OLS-RE (GD-PFOB)	OLS-FE (GD-PFOB)	OLS-RE (GD-Blau)	OLS-FE (GD-Blau)
Gender Diversity (GD)	-0.0017***	-0.0016***	-0.1377***	-0.1298***
	[3.6}	[3.09]	[3.99]	[3.52]
Board Size (Board)	-0.0291***	-0.0212***	-0.0286***	-0.0209***
	[10.43]	[6.92]	[7.58]	[4.81]
Proportion of Indp'n Directors (PIndDir)	-0.0022***	-0.0018***	-0.0022***	-0.0018***
	[7.87]	[5.97]	[5.61]	[4.13]
CEO Tenure (CEOT)	0.0009	-0.0035	0.0009	-0.0034
	[0.67]	[2.42]	[0.45]	[1.42]
CEO Duality (CEODua)	-0.0420	-0.0636	-0.0424	-0.0637
	[1.89]	[2.63]	[0.74]	[0.85]
Market Capitalisation (LogMC)	0.3115***	0.3530***	0.3121***	0.3532***
	[30.48]	[31.12]	[15.46]	[14.18]
Total Revenue (LogRev)	-0.0763***	-0.0742***	-0.0762***	-0.0742***
	[15.62]	[14.18]	[6.7]	[5.72]
Gearing Ratio (NDE)	-0.00004	-0.00001	-0.00004	-0.00001
	[1.46]	[0.46]	[0.93]	[0.28]
Volatility (VROE)	0.0022***	0.0021***	0.0022***	0.0021**
	[13.31]	[12.31]	[2.64]	[2.33]
# of observations	1981	1981	1981	1981
R^2	0.4026	0.4138	0.4039	0.415

Note to Table 4.11:

Table 4.11 reports the OLS regression results using both random effects (RE) and fixed effects (FE) estimations. Column 1 tabulates the variable and control variables used in this study in relation to the dependent variable Tobin's Q, the proxy for the performance measure of this study. Column 2 and 4 tabulate the results from random effects estimations (OLS-RE) using gender diversity measure (GD) of the proportion of female directors (PFOB) and the Blau index (Blau) respectively. Column 3 and 5 tabulate the results from fixed (OLS-FE) effects estimations using the same gender diversity measures. The model specifications for OLS method are as followed:

Random effects estimation: $P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \varepsilon_{it,}$ *and*

Fixed effects estimation is $P_{it} = \beta_0 + \beta_1 GD_{it} + \beta_k CV_{it} + \delta_i + \gamma_t + \varepsilon_{it,}$ *which includes company fixed effects* (δ_i) *and time fixed effects* (γ_t).

Tobin's Q is the measure of market performance, calculated from the ratio of the sum of the company's market value of equity and book value of debt to its book value of assets. GD represents board gender diversity measure. The proportion of female directors (PFOB) is the variable of interest and Blau index (Blau) is the gender diversity measure for the robustness test. Board control variables (BCV) comprise board size (Board), the proportion of independent directors (PIndDir), CEO tenure (CEOT) and the joint function of chairman and CEO (CEODua). The company-level control variables (CV) comprise the company's market capitalisation (LogMC), total revenue (LogRev), gearing ratio (NDE) and volatility (VROE). Table 3.1 in chapter 3 presents the definition of all variables of this study.

The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The regression results are adjusted for potential heteroskedasticity with variance robustness check. The second row of each explanatory variable shows the absolute value of t-statistics and z-statistics in brackets for the analysis. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |z| or Prob > |t| for random effects estimation and fixed effects estimation respectively.

4.4.2 Two Stage Least Square (2SLS) Instrumental Variable Method

In general, two-stage least square (2SLS) method is less preferred to ordinary least square (OLS) as OLS provides more consistent and efficient results if the explanatory variables are strictly exogenous to the dependent variable (Wooldridge, 2010). However, as the Durbin-Wu-Hausman endogeneity test in section 4.3.4[24] indicates that endogeneity issue exists in the structural model of this study, OLS method will no longer provide an unbiased estimate. Section 4.3.5 of this study has examined the pre-requisitions in applying the external instrumental variable where the external instrumental variable, the proportion of local female councillors, has fulfilled both the relevancy and the exogeneity requirements[25].

The presence of endogeneity in the structural model suggests that 2SLS instrumental variable method is an appropriate method compared to OLS estimator to minimise the biased estimation due to the endogeneity issue. The 2SLS instrumental variable method ignores the residual value in the original OLS estimation, and the external instrumental variable in the 2SLS has removed any confounding factors between the endogenous variable, the proportion of female directors, and the dependent variable, the company performance. The 2SLS instrumental variable method has been widely used in previous literature (Adams & Ferreira, 2009; Ahmed & Ali, 2017; Liu et al., 2014) to mitigate the possible causations of endogeneity issue such as reverse causality, measurement errors and omitted variables. This study uses the exogenous shock of the instrumental variable to address the potential endogenous relationship between board gender diversity and company performance.

Table 4.12 presents the regression results of the 2SLS instrumental variable analysis with an intention to mitigate the endogeneity concern in the structural model.

[24] Refer Table 4.8 for the results on the endogeneity test.

[25] Refer Table 4.10(a) and 4.10(b) and detail discussions on the selection of an external instrumental variable.

Table 4.12: 2SLS Regression Analysis Between Board Gender Diversity and Company Financial Performance

Explanatory Variables	Dependent Variable		
	PFOB	LogQ	
	First stage	PFOB (IV-FC)	Blau (IV-FC)
Gender Diversity (GD)		-0.0029	-0.2289
		[1.13]	[0.79]
Board Size (Board)	0.0861	-0.0211***	-0.0205***
	[0.41]	[6.82]	[4.48]
Proportion of Independent Directors (PIndDir)	0.1260***	-0.0016***	-0.0016**
	[5.54]	3.47]	[2.55]
CEO Tenure (CEOT)	0.1536	-0.0033	-0.0032
	[1.4]	[2.15]	[1.37]
CEO Duality (CEODua)	1.5176	-0.0618	-0.0621
	[0.72]	[2.52]	[0.81]
Market Capitalisation (LogMC)	0.8353	0.3545***	0.3547***
	[1.13]	[30.26]	[13.46]
Total Revenue (LogRev)	-0.0086	-0.0742***	-0.0742***
	[0.04]	[14.15]	[5.76]
Gearing Ratio (NDE)	-0.001	-0.00001	-0.00001
	[1.01]	[0.5]	[0.30]
Volatility (VROE)	0.00448	0.0021**	0.0021**
	[0.59]	[12.29]	[2.36]
Proportion of local Female Councillors (FC)	0.1364***		
	[5.32]		
# of observations	1981	1981	1981
External Instrument	-	FC	FC
R^2	0.1019	0.4112	0.4142

Note to Table 4.12:

Table 4.12 reports the 2SLS instrumental variable regression results using fixed effects (FE) estimations. Column 1 tabulates the variable of interest and control variables in relation to the dependent variable Tobin's Q (LogQ), the proxy for the performance measure of this study. Column 2 presents the first stage regression analysis in the 2SLS estimation using the proportion of female directors (PFOB) as the dependent variable to examine the relationship between this endogenous variable with the selected external instrumental variable, the proportion of local female councillors (FC). Column 3 and 4 tabulate the second stage regression results using gender diversity measures (GD), the proportion of female directors (PFOB) and the Blau index (Blau) respectively. Refer to note in Table 4.11 for variable descriptions of the control variables. The first stage regression and the second stage regression are:

1st stage regression: $GD_{it} = \alpha_0 + \alpha_1 FC + \alpha_k CV_{it} + v_{it}$

2nd stage regression: $P_{it} = \beta_0 + \beta \widehat{GD}_{it} + \beta_k CV_{it} + \varepsilon_{it}$

Where: $\widehat{GD}$ *is the predicted value of the gender diversity measure after taking into consideration of the external instrumental variable.*

The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The regression results are adjusted for potential heteroskedasticity with variance robustness check. The second row of each explanatory variable shows the absolute value of t-statistics and z-statistics in brackets for the first stage regression analysis and 2SLS analysis. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |t| or Prob > |z| for first stage instrumental regression and 2SLS fixed effects estimation respectively.

The discussions in section 4.3.5 suggest that the selected external instrumental variable, the proportion of local female councillors (FC), has fulfilled both the relevancy and exogeneity test in applying instrumental variable. Column 2 in Table 4.12 indicates that the proportion of local female councillors (FC) is significantly and positively correlated with the proportion of female directors (PFOB) at the 1% level. The coefficient of 0.14 suggests that a 1% increase in the local female councillors has a positive impact of 0.14 points on the local females board representation. This is in line with our arguments on the positive influence of political science in corporate governance (Terjesen et al., 2015) and the theory of economic ramification of distance (Bouwman, 2012). The effect of the proportion of local female councillors (FC) in 2SLS estimation has removed any confounding factors between the proportion of female directors (PFOB) and company financial performance (LogQ). This study uses the exogenous shock of the instrumental variable to address the possible endogenous relationship between board gender diversity and company performance.

After taking into consideration the first stage regression of the external instrumental variable, this study applies the predicted proportion of female directors in the second stage of the regression model. The results of the 2SLS instrumental variable indicate that there is no significant correlation between board gender diversity (GD), measured in the proportion of female directors (PFOB), and company performance, measured in Tobin's Q (LogQ). This contradicts the OLS regression results as tabulated in Table 4.11 where the proportion of female directors (PFOB) is highly significant and negatively correlated with company performance, Tobin's Q (LogQ), at the 1% level. The robustness test using the Blau index (Blau) as the board gender diversity (GD) measure yields similar results. These results indicate that when we apply the external instrumental variable into the structural model, the external instrumental variable has removed the possible confounding relationship between board gender diversity and company performance. The exogenous shock of the external instrumental variable addresses the possible endogenous relationship between board gender diversity and company financial performance. This reaffirms that the endogeneity issue is a

primary concern in diversity-performance studies and OLS estimation can be biased and results in suggesting a spurious correlation between board gender diversity and company performance.

In relation to other board-level control variables, the 2SLS estimation produces consistent results as the OLS estimation in both direction and magnitude of the parameter coefficient. Both board size (Board) and proportion of independent directors (PIndDir) show significant negative correlations with company financial performance at the 1% level. This suggests that larger board size has a negative impact on the company performance. This is consistent with Adams and Ferreira (2009) and Ahern and Dittmar (2012) studies, suggesting that board size is negatively correlated with board effectiveness and increase in agency costs. Similarly, the proportion of independent directors also has a negative impact on the company performance. This negative correlation contradicts the ASX Council's corporate governance guidelines[26] that advocate the majority of board members should comprise independent directors.

At the company level control variables, the 2SLS and OLS estimations also report consistent outcomes regarding the sign of the relationship and the magnitude of the coefficient. The control variable market capitalisation (LogMC) and the volatility measured by the standard deviation of return on equity (VROE) have significant and positive correlations with the company financial performance at the 1% level. On the other hand, total revenue (LogRev) has negative correlations with Tobin's Q while gearing ratio (NDE) of the companies has no significant impact on company performance. We will discuss the key findings and main results in the later section when we tabulate all econometric techniques and comparisons.

4.4.3 Generalised Method Of Moments (GMM) Method

The 2SLS instrumental variable estimation as discussed in section 4.4.2 deals with the endogeneity concern due to the unobserved time-invariant heteroskedasticity.

[26] ASX Corporate Governance Council's 2014 guidelines: Principle 2.4 of Corporate governance principles and recommendations.

It also mitigates the issue of simultaneity between the endogenous explanatory variable and the dependent variable. However, another possible concern in governance and performance studies is the dynamic endogeneity due to the dynamic relationship between board structure and performance in general (Schultz et al., 2010; Wintoki et al., 2012) and more specifically in board gender diversity and performance studies (Adams & Ferreira, 2009; T. Nguyen et al., 2015; Sila et al., 2016) . Prior studies in corporate governance and performance studies suggest the application of panel Generalised Method of Moments estimator (GMM) to alleviate the dynamic endogeneity concern (Schultz et al., 2010; Wintoki et al., 2012). The dynamic GMM method requires that there is no auto-correlation in the idiosyncratic errors and the instruments are valid and exogenous to the dependent variables.

This study applies Arellano and Bond (1991) two-step dynamic differenced GMM and Blundell and Bond (1998) two-step dynamic system GMM panel regression estimator with our dataset. Table 4.13 reports the regression results from dynamic GMM estimator by including past performance as the covariate in the model to address the endogeneity concern between the dynamic relationship between past performance and board gender diversity. The standard errors in the model are corrected for heteroskedasticity using variance robustness check. We also include the selected external instrumental variable, the proportion of local female councillors (FC), to account for all potential sources of endogeneity. Both techniques allow us to deal with the issues of the finite sample and dynamic nature of the dependent variable.

Table 4.13: Dynamic GMM Regression Analysis Between Board Gender Diversity and Company Financial Performance

Explanatory Variables	Dependent Variable - Log Q			
	DGMM(2)	SGMM(2)	DGMM(2): B	SGMM(2): B
Gender Diversity (GD)	0.0091	0.0027	0.1566	0.0449
	[0.27]	[0.64]	[0.05]	[0.16]
Board Size (Board)	-0.1398	-0.1032*	-0.1167	-0.0873
	[1.28	[1.93]	[0.91]	[1.62]
Proportion of Independent Directors (PIndDir)	-0.0136	-0.0061	-0.01	-0.0047
	[0.88]	[1.38]	[0.68]	[1.08]
CEO Tenure (CEOT)	0.0309	0.0168	0.0297	0.0185
	[0.97]	[1.19]	[0.73]	[1.28]
CEO Duality (CEODua)	0.5	0.6611	0.4115	0.6046
	[0.67]	[1.63]	[0.53]	[1.65]
Market Capitalisation (LogMC)	0.4752	0.2719**	0.4987*	0.2517**
	[1.49]	[2.43]	[1.65]	[2.23]
Total Revenue (LogRev)	-0.0922	-0.0363	-0.079	-0.0369
	[0.79]	[0.73]	[0.51]	[0.71]
Gearing Ratio (NDE)	-0.0015	-0.0005	-0.0011	-0.0004
	[0.57]	[0.60]	[0.38]	[0.59]
Volatility (VROE)	0.004	0.0066*	0.0027	0.006*
	[0.69]	[1.83]	[0.42]	[1.82]
Lagged of LogQ	0.4198	0.267*	0.4712	0.3084**
	[1.40]	[1.85]	[1.56]	[2.26]
# of observations	1393	1682	1393	1682
No of Instruments	13	26	13	26
AR(1) Test p-value	0.445	0.1	0.559	0.005
AR(2) Test p-value	0.48	0.54	0.6	0.69
Hansen Test of over-identification (p-value)	0.8	0.43	0.72	0.26
Difference-in-Hansen tests of exogeneity (p-value)	0.41	0.25	0.86	0.44

Note to Table 4.13:

Table 4.13 reports the two-step dynamic GMM estimations using both differenced and system GMM. Column 1 tabulates the variable aof interest and control variables of this study, and the dependent variable is Tobin's Q (LogQ), the proxy for the performance measure of this study. Column 2 and 4 present the dynamic differenced GMM using the gender diversity measure (GD), measured by the proportion of female directors (PFOB) and the Blau index (Blau) to examine the relationship between board gender diversity and company financial performance respectively. Column 3 and 5 tabulate the dynamic system GMM using the same gender diversity measures. We also include the lagged dependent variable (Lagged LogQ) to address the endogeneity caused by the past performance. Refer to note in Table 4.11 for variable descriptions of the control variables. The model specifications for the dynamic GMM is as follows:

$$\text{Dynamic GMM model: } \Delta P_{it} = \beta_1 \Delta P_{it-1} + \beta_2 \Delta GD_{it} + \beta_k \Delta CV_{it} + \Delta \varepsilon_{it}$$

The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The regression results are adjusted for potential heteroskedasticity using Windmeijer standard errors robustness check to correct for downward bias in two-step dynamic GMM estimation. The second row of each explanatory variable shows the absolute value of t-statistics in brackets for the regression analysis. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |t|.

The results of the dynamic GMM models show that the main focus of this study, the proportion of female directors on boards (PFOB) has no significant influence on the company performance. Interestingly, the direction of the relationship has changed from significantly negative in the OLS estimation to positive in the dynamic GMM models, although the relationship is insignificant. These results contradict the estimations as shown in the OLS's random effects and fixed effects methods. The significant negative correlation between board gender diversity and company financial performance may be caused by the omitted variable biases. When we include the dynamic relationship between the past performances and the external instrumental variable in the model, the highly negative significant correlations between board gender diversity and company financial performance as shown in the OLS estimation disappear, indicating that the endogeneity between board gender diversity and company financial performance may be caused by the simultaneity and dynamic endogeneity.

Regarding the board control variables, the dynamic GMM models also indicate that there is no significant correlation between board characteristics and company performance. The significant negative relationships between board size (Board) and the proportion of independent directors (PIndDir) disappear in dynamic GMM models. This indicates that it is essential to include past performance and an external instrumental variable to control for any dynamic nature in board characteristics and performance studies. At the company level, the dynamic GMM models also show no significant relationships between the company level control variables and company performance. The robustness tests using the alternative gender diversity measure, the Blau index (Blau), yield similar results.

Table 4.13 also presents the robustness check on the over-identifying issue of instruments and the validity of instruments. We examine the first difference residuals for auto-correlations using the Arellano-Bond test of second-order serial correlation. The results indicate the p-value for AR(2) for all four models using differenced GMM and system GMM are insignificant at the 10% level. This

suggests that we cannot reject the null hypothesis of no serial correlation, noting that there were enough lags of the instrumental variables to control for the dynamic relationship in the model. We also follow Roodman's (2009b) recommendation in implementing dynamic GMM model and in applying Hansen J-test of over-identifying restriction and the difference-in-Hansen test of exogeneity of instrument subsets. The null hypothesis for Hansen J-test of over-identification is the instruments are valid. The results show that the chi-square test statistics for all four models are insignificant at the 10% level, indicating that the instruments are valid. For the difference-in-Hansen test of exogeneity, the chi-square test statistics also reports an insignificant p-value at the 10% level, indicating that the instruments used in the model are exogenous.

4.4.4 Main Findings Of Regression Results

We note that the possible cause of the endogeneity issue in gender diversity and performance studies is the simultaneous causality between company financial performance and board gender diversity. In this instance, both current performance and past performance may influence boards' gender diversity. If past performance influences gender diversity of the board structure, we expect that companies that perform better will appoint more female directors on their boards. Meanwhile, the self-selection bias also causes an unclear casual relationship between board gender diversity and company financial performance when females choose to join better-performed companies. The feedback loops between gender-diverse boards and company financial performance make the relationships dynamic and complex. Following from previous governance and performance literatures (Schultz et al., 2010; Wintoki et al., 2012); this study applies the more sophisticated econometric techniques using 2SLS instrumental variable and dynamic GMM panel regression estimation to address the endogeneity issue.

Table 4.14 presents the comparative analysis of board gender diversity and company financial performance using different econometric estimators. The summary comparison between different econometric techniques allows us to compare this study with previous literatures and to demonstrate the most

appropriate estimations for this study. We illustrate all commonly used methods in corporate governance and performance studies, more particularly in board gender diversity and company financial performance studies.

We begin with the most commonly used method, the pooled OLS estimation in our comparative analysis. Column 2 and 3 of Table 4.14 present OLS methods using random effects (OLS-RE) and fixed effects (OLS-FE) estimators respectively. The results suggest a highly significant negative correlation between board gender diversity and company financial performance at the 1% level. The magnitude of the coefficient is consistent with both random effects and fixed effect estimations. The coefficient of 0.0016 means that with every increase of one percentage point of the proportion of female directors on boards (PFOB), the predicted value of Tobin's Q (LogQ) will decrease in average by 0.16%, with the assumption that every other variable remains constant and unchanged. While with other control variables, board size (Board), the proportion of independent directors (PIndDir), and total revenue (LogRev) are significantly and negatively correlated with company financial performance (LogQ). Market capitalisation (LogMC) and volatility (VROE) are positively correlated with performance. Although fixed effects estimators may correct for any unobserved heteroskedasticity that presents in the structural model, both estimations are not reliable as the significance of the variables and company financial performance may not fulfil the strict exogeneity assumptions. The endogeneity issues such as reverse causality, omitted variable biases, and measurement errors may be the main factor in the significant results.

Table 4.14: Comparison of Different Econometric Techniques - Regression Analysis Between Board Gender Diversity and Company Financial Performance

Explanatory Variables	Dependent Variable – Log Q				
	OLS-RE	OLS-FE	2SLS (IV)	Diff' GMM	Syst GMM
Gender Diversity (GD)	-0.0017***	-0.0016***	-0.0029	0.0091	0.0027
	[3.6}	[3.09]	[1.13]	[0.27]	[0.64]
Board Size (Board)	-0.0291***	-0.0212***	-0.0211***	-0.1398	-0.1032*
	[10.43]	[6.92]	[6.82]	[1.28	[1.93]
Proportion of Independent Directors (PindDir)	-0.0022***	-0.0018***	-0.0016***	-0.0136	-0.0061
	[7.87]	[5.97]	3.47]	[0.88]	[1.38]
CEO Tenure (CEOT)	0.0009	-0.0035	-0.0033	0.0309	0.0168
	[0.67]	[2.42]	[2.15]	[0.97]	[1.19]
CEO Duality (CEODua)	-0.0420	-0.0636	-0.0618	0.5	0.6611
	[1.89]	[2.63]	[2.52]	[0.67]	[1.63]
Market Capitalisation (LogMC)	0.3115***	0.3530***	0.3545***	0.4752	0.2719**
	[30.48]	[31.12]	[30.26]	[1.49]	[2.43]
Total Revenue (LogRev)	-0.0763***	-0.0742***	-0.0742***	-0.0922	-0.0363
	[15.62]	[14.18]	[14.15]	[0.79]	[0.73]
Gearing Ratio (NDE)	-0.00004	-0.00001	0	-0.0015	-0.0005
	[1.46]	[0.46]	[0.5]	[0.57]	[0.60]
Volatility (VROE)	0.0022***	0.0021***	0.0021***	0.004	0.0066*
	[13.31]	[12.31]	[12.29]	[0.69]	[1.83]
Lag 1 of Log Q				0.4198	0.267*
				[1.40]	[1.85]
# of observations	1981	1981	1981	1393	1682
# of instruments				13	26
R^2	0.4026	0.4138	0.4112		
AR(1) Test p-value				0.445	0.1
AR(2) Test p-value				0.48	0.54
Hansen Test of over-identification (p-value)				0.8	0.43
Difference-in-Hansen tests of exogeneity (p-value)				0.41	0.25

Note to Table 4.14:

Table 4.14 shows the comparison between the widely used econometric techniques in governance and performance studies, more particularly in board gender diversity and company performance. Column 1 tabulates the independent and control variables used in this study in relation to the dependent variable Tobin's Q (LogQ), the proxy for the performance measure of this study. Column 2 presents the regression results of OLS random effects (OLS-RE) estimator, column 3 presents OLS fixed effects (OLS-FE) estimator, column 4 presents 2SLS instrumental variable method (2SLS-IV), column 5 presents dynamic differenced GMM method, and column 6 presents the system GMM estimator. The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. Refer to note in Table 4.11 for the description of the variables and Table 3.5 in chapter 3 for the definition of all variables of this study. The regression results are adjusted for potential heteroskedasticity using Windmeijer standard errors robustness check to correct for downward bias in two-step dynamic GMM estimation. The second row of each explanatory variable shows the absolute value of t-statistics and z-statistics in brackets for the analysis. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |t| or Prob > |z|.

The Durbin-Wu-Hausman's endogeneity test as shown in Table 4.8 of section 4.3.4 confirms that there exists an endogeneity issue in the OLS structural model. This study then applies the most conventional method using 2SLS instrumental variable method to deal with the endogeneity concern between the endogenous explanatory variable and the dependent variable. The 2SLS instrumental variable method in column 4 of Table 4.14 allows the estimation to deal with the unobserved time-invariant heteroskedasticity and mitigates the issue of simultaneity between the endogenous explanatory variable and the dependent variable. The selected external instrumental variable of this study, the proportion of local female councillors (FC), fulfilled both the relevancy and exogeneity tests in applying an external instrumental variable. With the application of the carefully selected and valid external instrumental variable, the results in column 4 of Table 4.14 show that the proportion of female directors has no significant correlation with company performance. The regression results indicate that the spurious correlations as presented by OLS estimations are driven by the endogeneity concern. The external instrumental variable has removed the confounding effects between board gender diversity and company financial performance as estimated by the OLS methods. The correlations and the magnitude of coefficients for other control variables remain consistent between the 2SLS instrumental variable and the fixed effects estimator. The 2SLS instrumental method indicates that although the external instrumental variable is able to remove the confounding effects of board gender diversity and company performance, it does not take into account the dynamic nature of board structure and company performance.

To deal with endogeneity due to the dynamic relationship between board gender structure and company financial performance (Adams & Ferreira, 2009; T. Nguyen et al., 2015; Sila et al., 2016) , this study applies Arellano and Bond (1991) two-step dynamic differenced GMM and Blundell and Bond (1998) two-step dynamic system GMM panel regression estimators with our dataset. We include one year lagged of company financial performance as covariates and unobserved fixed panel-data

effects in the dynamic panel regression models (column 5 and 6 in Table 4.14) to address the endogeneity caused by the past performance that may influence the variables in the structural model. We also include the selected external instrumental variable, the proportion of local female councillors (FC), as the exogenous external instrumental variable to account for all potential sources of endogeneity. Following Windmeijer's (2005) suggestions on small sample correction, we apply two-step dynamic GMM estimation to deal with the issues of a finite sample and dynamic nature of the dependent variable in our study. The dynamic GMM results show that when we include the dynamic relationship together with the external instrumental variable in the structural model, the direction of the correlations between board gender diversity reverses from negative to positive, although it is not significant at the 10% level. This is a sharp contrast to the results presented by the OLS estimations, which produce biased and unreliable parameter estimates. The intuition for the sign reversal in dynamic GMM methods between board gender diversity and company financial performance can be due to unobserved heterogeneity and the dynamic relationship of past performance on board gender diversity.

In relation to other control variables in the model specification, all the significant correlations as reported in the OLS and the 2SLS estimations have turned into insignificant parameters in the GMM model. The insignificant of board characteristics with company financial performance is consistent with the findings in Australian studies by Pham, Suchard and Zein (2011) and Schultz et al. (2010). Both studies find no correlation between board structure and performance after controlling for endogeneity using dynamic GMM method. Neither board size (Board) nor the proportion of independent directors (PIndDir) is significant at the 5% level. The significant negative correlations between CEO tenure (CEOT) and CEO duality (CEODua) in fixed effects and 2SLS methods have changed direction to insignificant positive correlations. At the company level, all control variables have no significant correlation with company performance. The lagged performance of Tobin's Q also does not show a strong relationship with performance in differenced GMM and only report a weak positive correlation with the current performance at the 10% level with dynamic system GMM estimator. This suggests that the major endogeneity in the

model specification is caused by simultaneity or reverse causality and unobserved heterogeneity issues. Both dynamic GMM estimations, the differenced and system estimators are well specified as indicated in Hansen test of over-identifying restriction and the Arellano-Bond test of autocorrelation. Given the biased parameter estimation in the OLS methods and insufficient technique in the fixed effects and the 2SLS instrumental variable estimators, all studies that examine the relationship between corporate governance, and more particularly in board gender studies, and company financial performance should apply a dynamic GMM framework. The more important issue is to identify a truly exogenous external instrumental variable that is able to examine the main source of endogeneity.

4.5 Regression Analysis Based On Critical Mass Gender Grouping

This subsection presents the regression results obtained from the critical mass theory. We follow the similar presentation in section 4.4 and report the results from all the methodologies commonly apply to governance and board gender diversity studies with company performance. We then summarise the regression results and make a comparison of all these methodologies and conclude our main findings at the end of the section. The proponents of critical mass theory in board gender diversity studies suggest that female directors are likely to have an impact on boards' decision making when they achieve a critical mass of female board representation (Joecks et al., 2013; Konrald et al., 2008; Kristie, 2011; Strydom et al., 2017) . This study applies Kanter's (1977a) principal of critical mass theory and classifies the sample set based on the original Kanter's critical mass grouping and also the modified gender grouping as discussed in section 3.5.2.3[27]. The regression analyses of each of the econometric techniques are presented in the following section.

[27] The four gender groupings according to Kanter's classification are: (i) K1 (uniform group) – boards consist of all male directors; (ii) K2 (skewed group) – boards with at least one but less than twenty percentage of female directors; (iii) K3 (tilted group) - boards with at least twenty percentage but less than forty percentage of female directors; and (iv) K4 (balanced group) – boards with at least forty percentage of female directors. The modified critical mass classifications are: (i) ACM0 – boards consist of all male directors; (ii) ACM20 – boards with at least twenty percentage of female directors; (iii) ACM30 – boards consist of at least thirty percentage of female directors; and (iv) ACM40 – boards with at least forty percentage of female directors.

4.5.1 Ordinary Least Square Estimation

This study begins with the most commonly apply pooled OLS method using both random effects and fixed effects estimations. Based on the unbalanced panel sample data of 299 companies with 1981 firm-year observations for the entire period from 2008 to 2015, Table 4.15(a) and 4.15(b) present the summary regression results between the gender group categories according to the critical mass classification and company financial performance measured by Tobin's Q.

Refer to Tables 4.15(a) and 4.15(b); both regressions report consistent parameters estimation regarding the direction of the relationship between gender-diverse boards and performance. Both OLS estimations suggest that the correlation between boards with all male directors and company financial performance are positive and strongly significant at the 1% level. However, boards with at least twenty percent of female directors (ACM20) have a negative and significant correlation with company financial performance at the 5% level. Although boards with at least thirty and forty percent female directors (ACM30 and ACM40) have no significant effects on company performance, but they remain negatively correlated. For the control variables, company size (LogMC) and volatility (VROE), remain positive and significantly correlated with company financial performance across all different groups of the critical mass of female directors. On the other hand, board size (Board), the proportion of independent directors (PIndDir) and total revenue of companies (LogRev) remain significant and negatively correlated with company performance.

With the OLS random and fixed effects regression, there is the possibility that there exists an endogeneity issue in the relationship between gender-diverse-boards and company performance. Hence, the parameter estimations using OLS are not reliable and biased, even though fixed effects deal with the unobserved heterogeneity issue in the model. The subsequent analysis is undertaken to address these issues.

Table 4.15(a) Regression Analysis Between Board Gender Diversity and Company Financial Performance Based on Critical Mass Gender Grouping – OLS Random Effects

Explanatory Variables	Dependent Variable - Log Q				Dependent Variable - Log Q			
	K1	K2	K3	K4	ACM0	ACM20	ACM30	ACM40
Gender Diversity (GD)	0.0450***	-0.0153*	-0.0195**	-0.0218	0.0450***	-0.0226***	-0.0052	-0.0218
	[3.76]	[1.76]	[2.29]	[1.4]	[3.76]	[2.56]	[0.44]	[1.4]
Board Size (Board)	-0.0273***	-0.0288***	-0.0296***	-0.0296***	-0.0273***	-0.0296***	-0.0296***	-0.0296***
	[7.26]	[7.48]	[7.62]	[7.63]	[7.26]	[7.63]	[7.62]	[7.63]
Proportion of Indep'n Directors (PIndDir)	-0.0022***	-0.0025***	-0.0024***	-0.0025***	-0.0022***	-0.0024***	-0.0025***	-0.0025***
	[5.71]	[6.23]	[6.07]	[6.24]	[5.71]	[6.02]	[6.24]	[6.24]
CEO Tenure (CEOT)	0.0010	0.0009	0.0009	0.0009	0.0010	0.0009	0.0009	0.0009
	[0.47]	[0.45]	[0.44]	[0.43]	[0.47]	[0.43]	[0.43]	[0.43]
CEO Duality (CEODua)	-0.0428	-0.0424	-0.0419	-0.0423	-0.0428	-0.0421	-0.0419	-0.0423
	[0.75]	[0.74]	[0.73]	[0.74]	[0.75]	[0.74]	[0.73]	[0.74]
Market Capitalisation (LogMC)	0.3115***	0.3085***	0.3084***	0.3082***	0.3115***	0.3088***	0.3080***	0.3082***
	[15.51]	[15.29]	[15.25]	[15.23]	[15.51]	[15.26]	[15.2]	[15.23]
Total Revenue (LogRev)	-0.0762***	-0.0767***	-0.0766*	-0.0767***	-0.0762***	-0.0766*	-0.0767***	-0.0767***
	[6.69]	[6.67]	[6.67]	[6.66]	[6.69]	[6.67]	[6.66]	[6.66]
Gearing Ratio (NDE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.92]	[0.91]	[0.92]	[0.92]	[0.92]	[0.92]	[0.91]	[0.92]
Volatility (VROE)	0.0022***	0.0022***	0.0022***	0.0022***	0.0022***	0.0022***	0.0022***	0.0022***
	[2.65]	[2.62]	[2.62]	[2.61]	[2.65]	[2.62]	[2.61]	[2.61]
# of observations	1981	1981	1981	1981	1981	1981	1981	1981
R^2	0.404	0.399	0.3993	0.3981	0.404	0.3994	0.398	0.3981

Table 4.15(b) Regression Analysis Between Board Gender Diversity and Company Financial Performance Based on Critical Mass Gender Grouping – OLS Fixed Effects

Explanatory Variables	Dependent Variable - Log Q				Dependent Variable - Log Q			
	K1	K2	K3	K4	ACM0	ACM20	ACM30	ACM40
Gender Diversity (GD)	0.0418***	-0.0141	-0.0163*	-0.0136	0.0418***	-0.0186**	0.0013	-0.0136
	[3.28]	[1.62]	[1.92]	[1]	[3.28]	[2.1]	[0.12]	[1]
Board Size (Board)	-0.0197***	-0.0208***	-0.0215***	-0.0214***	-0.0197***	-0.0215***	-0.0214***	-0.0214***
	[4.57]	[4.81]	[4.88]	[4.88]	[4.57]	[4.88]	[4.87]	[4.88]
Proportion of Indep'n Directors (PIndDir)	-0.0018***	-0.0020***	-0.0020***	-0.0020***	-0.0018***	-0.0020***	-0.0020***	-0.0020***
	[4.25]	[4.68]	[4.53]	[4.68]	[4.25]	[4.5]	[4.69]	[4.68]
CEO Tenure (CEOT)	-0.0034	-0.0037	-0.0037	-0.0038	-0.0034	-0.0037	-0.0038	-0.0038
	[1.42]	[1.53]	[1.53]	[1.54]	[1.42]	[1.52]	[1.55]	[1.54]
CEO Duality (CEODua)	-0.0643	-0.0658	-0.0651	-0.0658	-0.0643	-0.0651	-0.0659	-0.0658
	[0.86]	[0.87]	[0.86]	[0.87]	[0.86]	[0.86]	[0.87]	[0.87]
Market Capitalisation (LogMC)	0.3526***	0.35156***	0.3513***	0.3514***	0.3526***	0.3514***	0.3513***	0.3514***
	[14.18]	[14.11]	[14.09]	[14.08]	[14.18]	[14.1]	[14.06]	[14.08]
Total Revenue (LogRev)	-0.0742***	-0.0742***	-0.0742***	-0.0742***	-0.0742***	-0.0742***	-0.0742***	-0.0742***
	[5.71]	[5.68]	[5.67]	[5.67]	[5.71]	[5.67]	[5.66]	[5.67]
Gearing Ratio (NDE)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	[0.27]	[0.24]	[0.25]	[0.25]	[0.27]	[0.26]	[0.24]	[0.25]
Volatility (VROE)	0.0021**	0.0021**	0.0021**	0.0021**	0.0021**	0.0021**	0.0021**	0.0021**
	[2.34]	[2.32]	[2.31]	[2.31]	[2.34]	[2.31]	[2.31]	[2.31]
# of observations	1981	1981	1981	1981	1981	1981	1981	1981
R^2	0.415	0.4113	0.4113	0.4106	0.415	0.4115	0.4105	0.4106

Note to Table 4.15(a) and (b):

Table 4.15(a) and (b) report the OLS random effects and fixed effects estimations regression results respectively. The gender diversity measures refer to the critical mass gender grouping using the proportion of female directors (PFOB). Based on Kanter's critical mass gender classification, K1 represents the uniform group, boards with no female directors on boards, K2 represents the skewed group of firm-year observations with at least one female director on boards but not exceeding 20% of female directors; K3 represents the tilted group of firm-year observations with at least 20% but not exceeding 40% of female directors. K4 represents the balanced group of firm-year observations with at least 40% of female directors. The groupings with the abbreviations of ACM represent the modified gender grouping based on firm-year observations with a minimum of proportion females in an incremental order. ACM0 represents the group of firm-year observations with no female directors on boards, while ACM20, ACM30, and ACM40 represent the group of firm-year observations with at least 20%, 30% and 40% of female directors on boards respectively. Tobin's Q is the measure of company performance, calculated from the ratio of the sum of the company's market value of equity and book value of debt to its book value of assets. Refer notes in Table 4.11 for the description of other control variables and Table 3.5 in Chapter 3 for detailed definition of the variables.

Column 1 tabulates the variable of interest and control variables used in this study in relation to the dependent variable Tobin's Q, the proxy for the performance measure of this study. Column 2 to 5 with green shading tabulates the results according to Kanter's critical mass classification. Column 6 to 9 with blue shading tabulate the results according to the modified critical classification.

The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The regression results are adjusted for potential heteroskedasticity using Windmeijer standard errors robustness check to correct for downward bias in two-step dynamic GMM estimation. The second row of each explanatory variable shows the absolute value of t-statistics and z-statistics in brackets for the analysis. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |z| | or Prob > |t| for random effects estimation and fixed effects estimation respectively.

4.5.2 Two-Stage-Least Square Regression Analysis

Extending from the entire dataset analysis with the 2SLS instrumental variable estimation, we continue to use this method with critical mass gender classification to examine the relationship of gender-diverse boards with company financial performance to mitigate the possible endogeneity issue due to simultaneity. Using the same external instrumental variable, the proportion of local female councillors, we create a dummy variable for each classification of the critical mass of the proportion of local female councillors[28] based on the same classification of the critical mass of the proportion of female directors[29]. We then match the critical mass of local female councillors, as the external instrumental variable, to the critical mass of the proportion female directors in our analysis. Table 4.16 presents the 2SLS instrumental variable analysis using the critical mass gender classification.

The results for category K1 and ACM0 indicate that the gender diversity measure is being omitted. This is because there is a multicollinearity issue with the proportion of local female councillors. As the dummy variable measures the proportion of local female councillors are all zero, indicating that all the local councils' board are represented with at least one female councillor, we are unable to produce the parameter estimation for this category. While for all other gender groups with critical mass classification, none of the groupings shows a significant relationship between the gender-diverse boards and company financial performance. This reaffirms that the significant negative correlation in OLS estimation for gender category ACM20 is biased due to the endogeneity concern. The results for other control variables remain consistent with the overall dataset, where board size, the proportion of independent directors and total revenue remain negatively correlated with company financial

[28] The gender critical mass classification for the proportion of local female councillors in relation to Kanter's classification are: (i) FCK1 (uniform group) – local councils that consist of all male councillors; (ii) FCK2 (skewed group) – local councils with at least one but less than twenty percentage of female councillors; (iii) FCK3 (tilted group) – local councils with at least twenty percentage but less than forty percentage of female councillors; and (iv) FCK4 (balanced group) – local councils with at least forty percentage of female councillors. The modified critical mass classifications for the proportion of local female councillors are: (i) FCACM0 – local councils consist of all male councillors; (ii) FCACM20 – local councils with at least twenty percentage of female councillors; (iii) FCACM30 – local councils consist of at least thirty percentage of female councillors; and (iv) FCACM40 – local councils with at least forty percentage of female councillors.

[29] Refer Section 3.5.2.3 for the four gender groupings according to Kanter's and the modified critical mass classifications.

performance, and company size and volatility are positively correlated with company financial performance.

Table 4.16: Regression Analysis Between Board Gender Diversity and Company Financial Performance Based on Critical Mass Grouping - 2SLS Instrumental Variable

Explanatory Variables	Dependent Variable - Log Q				Dependent Variable - Log Q			
	K1	K2	K3	K4	ACM0	ACM20	ACM30	ACM40
Gender Diversity (GD)	Omitted	-0.7509	-0.0205	-2.2283	Omitted	-1.8503	-1.1832	-2.2283
		[0.77]	[0.08]	[0.74]		[0.33]	[1.25]	[0.74]
Board Size (Board)	-0.0214***	0.0126	-0.0215***	-0.0238***	-0.0214***	-0.0304	-0.0295***	-0.0238***
	[4.88]	[0.28]	[4.94]	[2.92]	[4.88]	[0.95]	[3.03]	[2.92]
Proportion of Indep'n Directors (PIndDir)	-0.0020***	-0.0009	-0.0020**	-0.0013	-0.0020***	0.0049	-0.0001	-0.0013
	[4.69]	[0.62]	[1.77]	[1.21]	[4.69]	[0.24]	[0.09]	[1.21]
CEO Tenure (CEOT)	-0.0038	-0.0010	-0.0037	-0.0019	-0.0038	0.0039	-0.0042	-0.0019
	[1.55]	[0.17]	[1.35]	[0.54]	[1.55]	[0.17]	[1.09]	[0.54]
CEO Duality (CEODua)	-0.0658	-0.0681	-0.0649	-0.0693	-0.0658	0.0046	0.0172	-0.0693
	[0.87]	[0.79]	[0.87]	[0.93]	[0.87]	[0.02]	[0.13]	[0.93]
Market Capitalisation (LogMC)	0.3513***	0.3679***	0.3513***	0.3699***	0.3513***	0.3686***	0.3669***	0.3669***
	[14.08]	[9.04]	[14.11]	[9.4]	[14.08]	[5.2]	[10.36]	[9.4]
Total Revenue (LogRev)	-0.0742***	-0.0735***	-0.0742***	-0.0751***	-0.0742***	-0.0758***	-0.0703***	-0.0751***
	[5.67]	[5.55]	[5.67]	[5.73]	[5.67]	[4.19]	[4.97]	[5.73]
Gearing Ratio (NDE)	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001	0.0000	0.0000
	[0.24]	[0.12]	[0.25]	[0.65]	[0.24]	[0.36]	[0.68]	[0.65]
Volatility (VROE)	0.0021**	0.0023**	0.0021**	0.0020**	0.0021**	0.0023**	0.0019**	0.0020**
	[2.31]	[2.38]	[2.31]	[2.19]	[2.31]	[2.12]	[1.97]	[2.19]
# of observations	1981	1981	1981	1981	1981	1981	1981	1981
R^2	0.4105	0.065	0.4112	0.0694	0.4105	0.0196	0.0778	0.0694

Note to Table 4.16:

Table 4.16 reports the 2SLS instrumental variable estimations regression results using the critical mass gender grouping for the proportion of female directors (PFOB) and external instrumental variable, the proportion of local female councillors (FC). Refer to note in Table 4.15 for the detailed description of critical mass groupings. Tobin's Q is the measure of company financial performance of this study, calculated from the ratio of the sum of the company's market value of equity and book value of debt to its book value of assets. Refer notes in Table 4.11 for the description of other control variable and Table 3.5 in Chapter 3 for detailed definition of the variables.

Column 1 tabulates the variable of interest and control variables used in this study in relation to the dependent variable Tobin's Q, the proxy for the performance measure of this study. Column 2 to 5 with green shading tabulates the results according to Kanter's critical mass classification. Column 6 to 9 with blue shading tabulate the results according to the modified critical classification.

The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The regression results are adjusted for potential heteroskedasticity using Windmeijer standard errors robustness check to correct for downward bias in two-step dynamic GMM estimation. The second row of each explanatory variable shows the absolute value of t-statistics in brackets for the analysis. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |t|.

4.5.3 Dynamic GMM Estimator Regression Analysis

In the gender critical mass classification setting, this study also deals with endogeneity concern arising from the dynamic nature of gender-diverse boards and company performance, as well as the effects of past performance on current performance using dynamic GMM techniques. Consistent with the entire dataset analysis, this study applies Arellano and Bond (1991) two-step dynamic differenced GMM and Blundell and Bond (1998) two-step dynamic system GMM panel regression estimator. The critical mass classification analysis also includes one year lagged of company's performance as covariates to account for the dynamic nature of past performance. The critical mass classification of the proportion of local female councillors is included as the external instrumental variable to account for all other potential sources of endogeneity. We apply the same principal as the 2SLS instrumental variable's critical mass classification of the proportion of local female councillors[30] and the critical mass of the proportion female directors[31]. We then match the critical mass of local female councillors as the external instrumental variable, to the critical mass of the proportion of female directors in our analysis. Table 4.17(a) and 4.17(b) present the differenced and system dynamic GMM results respectively.

The regression results show that all critical mass groupings of the proportion of female directors have no significant correlation with company performance. Furthermore, all board-level control variables also do not correlate with company performance. These results contrast with the significant negative relationship of board gender diversity (GD), board size (Board) and the proportion of independent directors (PIndDir) in the OLS method. The insignificant correlations of board gender diversity (GD) and other board-level control variables with company financial performance indicate that it is important to include past performance (L.1 LogQ) and external instrumental variable (FC) to control for any dynamic nature in board characteristics and company financial performance studies. At the company level,

[30] Refer footnote 26 for the critical mass classification of the proportion of local female councillors groupings.
[31] Refer section 3.5.2.3 for the critical mass classification of the proportion of female directors on boards.

only the control variable company size, measured in market capitalisation (LogMC), shows a significant correlation with company performance.

The dynamic GMM results in Table 4.17(a) and 4.17(b) also report the Arellano-Bond test of second-order serial correlation. The results suggest the p-value for AR(2) for both differenced GMM and system GMM are insignificant at the 10% level, suggesting that we cannot reject the null hypothesis of no serial correlation. Furthermore, Hansen J-test of over-identifying restriction and the difference-in-Hansen test of exogeneity of instrument subsets show that the chi-square test statistics for the dynamic GMM estimations are insignificant at the 10% level. Both tests for instrument's relevancy and exogeneity indicate that the instruments are valid and exogenous in the dataset. We will discuss the detail findings in the next section by comparing all the econometric techniques employed in this study.

Table 4.17(a): Regression Analysis Between Board Gender Diversity and Company Financial Performance Based on Critical Mass Grouping- Dynamic Differenced GMM Estimation

Explanatory Variables	Dependent Variable - Log Q				Dependent Variable - Log Q			
	K1	K2	K3	K4	ACM0	ACM20	ACM30	ACM40
Gender Diversity (GD)	0.0353	-0.0050	-0.2554	0.2133	0.0353	0.0027	0.1566	0.0449
	[0.11]	[0.06]	[0.74]	[1.03]	[0.11]	[0.64]	[0.05]	[0.16]
Board Size (Board)	-0.0893	-0.1330	-0.0570	-0.0238	-0.0893	-0.1032*	-0.1167	-0.0873
	[0.6]	[1.69]	[0.75]	[0.38]	[0.6]	[1.93]	[0.91]	[1.62]
Proportion of Indep'n Directors (PIndDir)	0.0009	-0.0107	-0.0138	0.0048	0.0009	-0.0061	-0.0100	-0.0047
	[0.04]	[1.11]	[2.21]	[0.62]	[0.04]	[1.38]	[0.68]	[1.08]
CEO Tenure (CEOT)	0.0587	0.0424	-0.0073	-0.0130	0.0587	0.0168	0.0297	0.0185
	[1.19]	[1.3]	[0.3]	[0.18]	[1.19]	[1.19]	[0.73]	[1.28]
CEO Duality (CEODua)	0.9974	-0.4673	-0.4750	0.6424	0.9974	0.6611	0.4115	0.6046
	[1.15]	[0.53]	[0.67]	[0.59]	[1.15]	[1.63]	[0.53]	[1.65]
Market Capitalisation (LogMC)	0.2968	0.8752***	0.6714**	0.3532	0.2968	0.2719**	0.4987*	0.2517**
	[1.39]	[2.53]	[2.18]	[0.83]	[1.39]	[2.43]	[1.65]	[2.23]
Total Revenue (LogRev)	-0.1298	-0.0795	-0.0216	-0.0604	-0.1298	-0.0363	-0.0790	-0.0369
	[1.12]	[0.83]	[0.23]	[0.45]	[1.12]	[0.73]	[0.51]	[0.71]
Gearing Ratio (NDE)	-0.0010	0.0004	-0.0012	-0.0028	-0.0010	-0.0005	-0.0011	-0.0004
	[0.76]	[0.31]	[1.16]	[1.04]	[0.76]	[0.6]	[0.38]	[0.59]
Volatility (VROE)	0.0051	-0.0003	-0.0004	0.0056	0.0051	0.0066*	0.0027	0.0060
	[1.5]	[0.07]	[0.15]	[1.05]	[1.5]	[1.83]	[0.42]	[1.82]
L1. of Tobin's Q	0.0000	0.0000	0.0000	0.0000	0.0000	0.267*	0.4712	0.3084**
	[0]	[0]	[0]	[0]	[0]	[1.85]	[1.56]	[2.26]
# of observations	1393	1393	1393	1393	1393	1682	1393	1682
No of Instruments	12	13	13	12	12	26	13	26
AR(1) Test p-value	0.107	0.315	0.134	0.359	0.107	0.1	0.559	0.005
AR(2) Test p-value	0.47	0.51	0.28	0.43	0.47	0.54	0.60	0.69
Hansen Test of over-identification (p-value)	1.00	0.64	0.92	0.97	1.00	0.43	0.72	0.26
Difference-in-Hansen tests of exogeneity (p-value)	0.41	0.343	0.82	0.82	0.41	0.246	0.857	0.442

Table 4.17(b): Regression Analysis Between Board Gender Diversity and Company Financial Performance Based on Critical Mass Grouping - Dynamic System GMM Estimation

Explanatory Variables	Dependent Variable - Log Q				Dependent Variable - Log Q			
	K1	K2	K3	K4	ACM0	ACM20	ACM30	ACM40
Gender Diversity (GD)	0.1005	-0.0622	0.0596	0.3506	0.1005	0.0571	0.1630	0.3506
	[1.62]	[1.51]	[0.81]	[1.13]	[1.62]	[0.81]	[1.51]	[1.13]
Board Size (Boards)	-0.1096	-0.0382	-0.0653	0.0237	-0.1096	-0.0885	-0.0627	0.0237
	[3.23]	[1.43]	[1.35]	[0.31]	[3.23]	[1.86]	[1.06]	[0.31]
Proportion of Indep'n Directors (PIndDir)	-0.0075	-0.0027	-0.0020	0.0082	-0.0075	-0.0053	0.0005	0.0082
	[1.88]	[1.2]	[0.52]	[1.12]	[1.88]	[1.58]	[0.08]	[1.12]
CEO Tenure (CEOT)	0.0045	0.0091	0.0085	-0.0265	0.0045	-0.0058	-0.0015	-0.0265
	[0.24]	[0.75]	[0.38]	[0.49]	[0.24]	[0.23]	[0.07]	[0.49]
CEO Duality (CEODua)	0.2577	0.3888	0.4377	1.5020	0.2577	0.5197	0.7655	1.5020
	[0.85]	[1.35]	[1.49]	[1.45]	[0.85]	[1.53]	[1.5]	[1.45]
Market Capitalisation (LogMC)	0.3660***	0.2713	0.1690	-0.1066	0.3660***	0.3106**	0.1715	-0.1066
	[3.16]	[2.74]	[1.24]	[0.42]	[3.16]	[2.38]	[1.02]	[0.42]
Total Revenue (LogRev)	0.0131	-0.0156	-0.0212	0.0489	0.0131	0.0014	-0.0102	0.0489
	[0.43]	[0.31]	[0.3]	[0.47]	[0.43]	[0.02]	[0.14]	[0.47]
Gearing Ratio (NDE)	-0.0002	-0.0004	-0.0004	-0.0064	-0.0002	0.0000	-0.0011	-0.0064
	[0.37]	[0.68]	[0.6]	[1.32]	[0.37]	[0]	[1.25]	[1.32]
Volatility (VROE)	0.0052	0.0031	0.0039	0.0065	0.0052	0.0054	0.0077	0.0065
	[2.07]	[0.92]	[1.13]	[1.29]	[2.07]	[1.4]	[1.8]	[1.29]
L1. of Tobin's Q	0.2893	0.4303***	0.4232**	0.4125	0.2893	0.2451	0.3326*	0.4125
	[1.58]	[2.86]	[2.34]	[1.34]	[1.58]	[1.11]	[1.7]	[1.34]
# of observations	1682	1682	1682	1682	1682	1682	1682	1682
No of Instruments	25	26	26	25	25	26	26	25
AR(1) Test p-value	0	0.016	0.004	0.274	0	0.006	0.066	0.274
AR(2) Test p-value	0.44	0.96	0.92	0.40	0.44	0.73	0.56	0.40
Hansen Test of over-identification (p-value)	0.73	0.17	0.14	1.00	0.73	0.63	0.90	1.00
Difference-in-Hansen tests of exogeneity (p-value)	0.25	0.557	0.153	0.86	0.25	0.57	0.715	0.86

Note to Table 4.17 (a) and (b):

Table 4.17 (a) and (b) report the two-step dynamic GMM estimations regression results using to the critical mass gender grouping for the proportion of female directors (PFOB). We include one-year lag of dependent variable Tobin's Q and external instrumental variable, the proportion of local female councillors in the structural model. Refer to note in Table 4.15 for the detailed description of critical mass groupings. Tobin's Q is the measure of market performance, calculated from the ratio of the sum of the company's market value of equity and book value of debt to its book value of assets. Refer notes in Table 4.11 for the description of other control variable and Table 3.5 in Chapter 3 for detailed definition of the variables.

Column 1 tabulates the variable of interest and control variables used in this study in relation to the dependent variable Tobin's Q, the proxy for the performance measure of this study. Column 2 to 5 with green shading tabulates the results according to Kanter's critical mass classification. Column 6 to 9 with blue shading tabulate the results according to the modified critical classification.

The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The regression results are adjusted for potential heteroskedasticity using Windmeijer standard errors robustness check to correct for downward bias in two-step dynamic GMM estimation. The second row of each explanatory variable shows the absolute value of t-statistics in brackets for the analysis. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |t|.

4.5.4 Key Findings Of Critical Mass Analysis

Table 4.18 presents the comparative regression results of board gender diversity and company financial performance for all econometric techniques employed in this study using the critical mass groupings.

The critical mass theory suggests that the real influence of female directors on boards' decision and company financial performance are likely to have significant impacts only when there are sufficient number or representation of female directors as a group on the board of directors (Joecks et al., 2013; Konrald et al., 2008; T. Nguyen et al., 2015; Torchia et al., 2011) . This section analyses the effects of different proportion of female board representation on company financial performance based on this theory. Using the OLS method with random and fixed effects estimators as shown in Panel A and Panel B of Table 4.18, these estimations suggest that Kanter's classification of tilted groups of female directors (K3) and boards with at least thirty percent of female directors (ACM30) have a significant negative correlation with company financial performance. The negative bias effect is expected when we estimate the relationships in a structural model without taking into consideration of the endogeneity problems between the variables and the possibility of dynamic relationships of past performance on the explanatory variables (Wintoki et al., 2012). On the other hand, the results also show that boards with all-male directors have significant positive correlations with company financial performance. These results contrast with previous research that supports the theory of critical mass of female directors and positive correlation with company performance (Joecks et al., 2013; Konrad et al., 2008; Liu et al., 2014; Nguyen et al., 2015; Torchia et al., 2011).

Table 4.18: Comparison of Regression Analysis Between Board Gender Diversity and Company Financial Performance- Critical Mass Grouping

	Dependent Variable - Log Q				Dependent Variable - Log Q			
Panel A:	**Estimation Method: OLS - RE**							
Critical mass classification	**K1**	**K2**	**K3**	**K4**	**ACM0**	**ACM20**	**ACM30**	**ACM40**
Coefficient of Gender Diversity (GD)	0.0450***	-0.0153*	-0.0195**	-0.0218	0.0450***	-0.0226***	-0.0052	-0.0218
	[3.76]	[1.76]	[2.29]	[1.4]	[3.76]	[2.56]	[0.44]	[1.4]
Panel B:	**Estimation Method: OLS-FE**							
Coefficient of Gender Diversity (GD)	**0.0418*** **	-0.0141	**-0.0163***	-0.0136	**0.0418*** **	**-0.0186** **	0.0013	-0.0136
	[3.28]	[1.62]	[1.92]	[1]	[3.28]	[2.1]	[0.12]	[1]
Panel C:	**Estimation Method: 2SLS(IV)**							
Coefficient of Gender Diversity (GD)	Omitted	-0.7509	**-0.0205**	-2.2283	Omitted	**-1.8503**	-1.1832	-2.2283
		[0.77]	[0.08]	[0.74]		[0.33]	[1.25]	[0.74]
Panel D:	**Estimation Method: Diff'n GMM - Two step (FC)**							
Coefficient of Gender Diversity (GD)	**0.0353**	-0.005	**-0.2554**	**0.2133**	**0.0353**	**0.0027**	**0.1566**	**0.0449**
	[0.11]	[0.06]	[0.74]	[1.03]	[0.11]	[0.64]	[0.05]	[0.16]
Panel E:	**Estimation Method: System GMM - Two Step (FC)**							
Coefficient of Gender Diversity (GD)	**0.1005**	-0.0622	**0.0596**	**0.3506**	**0.1005**	**0.0571**	**0.163**	**0.3506**
	[1.62]	[1.51]	[0.81]	[1.13]	[1.62]	[0.81]	[1.51]	[1.13]

Note to table 4.18:

The sample set consists of unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. Panel A and B present the OLS method using random effects (OLS-RE) and Fixed effects (OLS-FE) respectively. Panel C, D and E presents the application of external instrumental method using different techniques of 2SLS, differenced GMM and system GMM. This table only focuses on board gender diversity (GD) measure as it is the main focus variable of this study. Refer to note in Table 4.15 for the gender critical mass groupings and classification of the proportion of female directors. The first row shows the correlation between the board gender diversity (GD) and company financial performance (LogQ), and the second row shows the absolute value of t/z-statistics in brackets. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |t| or Prob > |z|.

To deal with the unobserved time-invariant heteroskedasticity and mitigates the simultaneity issue between the explanatory variable and the dependent variable, we apply the 2SLS instrumental variable method using the critical mass classification of the proportion of local female councillors as the external instrumental variable. The results in Panel C of Table 4.18 show that the 2SLS instrumental variable technique manages to remove the confounding effects between gender-diverse boards and company financial performance for the tilted group of female directors (K3) and boards with at least thirty percent of female directors (ACM30). The significant negative correlations between these two groups of female directors with company financial performance have disappeared. Overall, the 2SLS instrumental variable estimation reports the critical mass of female directors has no significant correlation with company performance.

This study applies both Arellano and Bond (1991) two-step dynamic differenced GMM and the Blundell and Bond (1998) two-step dynamic system GMM panel regression estimator to overcome the short-coming in the 2SLS instrumental variable method in addressing the more advanced endogeneity issues. These techniques enable us to include both past performance and fixed effects of company-level characteristics to account for the complex and dynamic relationships of governance/diversity and company financial performance in the model. We also classify the exogenous external instrumental variable, the proportion of local female councillors, into the critical mass classification as the endogenous variable, the proportion of female directors, to account for all potential sources of endogeneity.

Using the more advanced econometric techniques with dynamic GMM estimations, as contrast to the regression results in the OLS, the regression results in Panel D and E of Table 4.18 indicate that the boards with all male directors have no positive significant correlation with company performance. This suggests that the significant positive correlations in the OLS estimations (OLS-RE and OLS-FE) are biased and unreliable. More interestingly, the change in direction of the relationship for tilted group (K3) and balanced group (K4), and boards with at least twenty (ACM20), thirty

(ACM30) and forty (ACM40) percent of female directors suggest the biased parameter estimates in the OLS methods are due to the unobserved heterogeneity and the dynamic relationships between board gender diversity and company performance.

The study suggests that the change in the direction of the relationship between board gender diversity and company financial performance is potentially due to some unobserved heterogeneity of past performance and simultaneous causality between board gender diversity and past performance. As suggested by Adams and Ferreira (2009), gender-diverse boards may allocate more effort in monitoring. Hence, imposing gender quotas in well-governed boards may reduce company performance. In this instance, well-governed companies may improve company financial performance but over monitored companies may have negative implications on company performance. In addition, past performance may be another attribute that determines board structure where females choose to join a better-performed company, or good governance practice companies simply have gender diversity measure on the boards. The OLS estimations in Panel A and B of Table 4.18 indeed report a significant negative correlation between gender-diverse boards and company financial performance due to ignoring the past performance and unobserved company characteristics. The results show that gender-diverse boards, with the critical mass classification of the proportion of female directors, show no relationship with company performance. In addition, there is no sign of any adverse correlation between board gender diversity and company financial performance as suggested by the OLS estimations.

Both dynamic GMM estimations, the differenced and system methods, are well specified as indicated by Arellano-Bond test of second-order serial correlation, Hansen J-test of over-identifying restriction and the difference-in-Hansen test of exogeneity of instrument subsets. The analysis for serial correlation indicates that the differenced unobserved time-invariant component is uncorrelated to the second-order of the dependent variable. This addresses the endogeneity concern caused by the unobserved heterogeneity in the system. Hansen J-test of the over-identifying test

also suggests that the instruments used in the model are valid. The difference-in-Hansen test of exogeneity of instrument subsets indicates that the external instrument applied in this study is exogenous. In view of the biased parameter estimation in the OLS and insufficient technique in the fixed effects and the 2SLS instrumental variable estimators, all studies examining the relationship between corporate governance and performance studies, and more particularly in boards gender diversity studies, should apply the dynamic GMM framework. Most important is the identification of a truly exogenous and valid external instrumental variable that is able to examine the main source of endogeneity.

4.6 Chapter Summary And Conclusion of the Findings

The findings of this study suggest that female board representation has neither positive nor negative implications on company performance, as measured by Tobin's Q. This indicates previous findings of significant negative implications as suggested in the OLS random effects and fixed effects estimations are due to spurious correlation caused by endogeneity issues. The change of direction of the relationship from significant negative correlations in the OLS methods to insignificant positive correlations in the GMM methods used in this study indicates that female board representation does not lead to poor performance after accounting for the endogeneity concerns. Although females board representation has no significant positive impacts on company performance, board gender diversity will not cause the decrease in the company's capacity to create value with the existing use of company's resources, measured by Tobin's Q. The summary statistics show that female board representation has increased in an upward trend after The Australian Stock Exchange Corporate Governance Councils' gender diversity recommendations. However the statistics show that only five percent of the firm-year observations have at least thirty percent of female directors on boards. Only two percent of the firm-year observations in this sample have at least forty percent female directors on their boards. The low proportion of female directors on boards could be one of the reasons for the insignificant relationship between gender-diverse boards and company performance. Despite the insignificant results, the extension of this study using critical mass classification reveals that the magnitude of the positive

implications of gender-diverse boards is greater when there are more female directors on boards. The coefficient of boards with at least forty percent of female directors is higher than the coefficient of boards with at least thirty and twenty percent of female directors on boards.

The OLS estimations of this study contrast with the Australian empirical evidences on the relationship between board gender diversity and company performance. As shown in Bonn (2004) and Nguyen and Faff's (2007) OLS analysis, both studies report a significant positive correlation between board gender diversity and company value. Theoretically, the study also suggests contradicting results to resource dependency theory. Resource dependency theory predicts positive correlations between female board representation and company financial performance because female directors contribute the diverse perspectives and knowledge into the board decision-making process. The contradicting results may be due to biases caused by unobserved board-level or company-level characteristics. For example, shareholders respond positively to company's gender diversity policy and good governance measures, which improve the market value of the company (Campbell & Minguez Vera, 2010; Kang et al., 2010) , and subsequently the measure of Tobin's Q. Post and Byron (2015) in their meta-analysis of 140 studies also suggest that countries with stronger shareholders protections motivate boards to use different experience and knowledge, and gender-diverse boards are positively associated with company performance. As the OLS estimations fail to control for simultaneous causality, unobserved company-level heterogeneity (Sila et al., 2016) and the dynamic relationships amongst the variables in the structural model (Wintoki et al., 2012), it can lead to spurious negative correlation and biased parameter estimates.

To overcome the endogeneity issues, then we apply an exogenous external instrumental variable using the 2SLS instrumental variable method to estimate the model parameters. The significant negative correlations between boards gender diversity and company financial performance in the OLS estimations disappear. Theoretically, this is in line with the agency theory where gender-diverse boards improve boards' monitoring function and reduce agency cost (Jurkus et al., 2011).

However, over monitoring in well-governed companies may increase agency cost (Adams & Ferreira, 2009) and be detrimental to management's performance. The external instrumental variable manages to remove the confounding effects between the gender-diverse boards and company performance, and results in a negative but insignificant correlation.

Empirically, when using more advanced econometric techniques such as dynamic GMM panel regression and an external instrumental variable, the correlations between board gender diversity and company financial performance are not statistically significant although the sign changes from negative to positive, after accounting for dynamic endogeneity, simultaneous causality and unobserved heterogeneity. Furthermore, the significant correlations between board characteristics, board size and board independence, and company financial performance disappear. This suggests that the significant relationships between board structure and company financial performance using the OLS and fixed effects estimations are spurious. This also indicates that any changes in the board structure and composition will have no impact on company performance. The results of the dynamic GMM estimation are consistent with the corporate governance studies suggesting that there is no significant relationship between corporate governance measures and company financial performance(Pham et al., 2011; Schultz et al., 2010; Wintoki et al., 2012). The insignificant results in Tobin's Q also suggest that there may be other influences on this performance measure. Further research is needed to determine the true impact of board gender diversity and board structure on company financial performance as measured by Tobin's Q.

In lieu to tokenism and critical mass theory, the proponents of the critical mass of female board representation suggest that boards with three female directors perform better than boards with a token female or boards with all male directors (Liu et al., 2014; T. Nguyen et al., 2015). This supports Kristie (2011) argument that one woman is a 'token', two is a 'presence' and three is a 'voice'. However, the results of this study do not suggest any significant correlation between boards with the different critical mass groupings as suggested by Kanter (1977b) as well

as the amended critical mass grouping as suggested in this study. Although we are unable to support the critical mass of female board representation, our results do not demonstrate negative signs or any adverse correlation with the increment of female board representation and company performance. That is increasing number of female board members does not reduce company performance.

The biased positive and significant coefficient estimates between all male boards (K1 and ACM0) and company financial performance in the OLS regression have changed to insignificant when we apply the GMM method. This indicates that boards with all male directors do not perform better than other heterogeneous boards that contain female directors. Furthermore, the significant negative correlations of boards that consist of at least twenty percent female directors (ACM20) in the OLS estimations have reversed sign to positively correlated but insignificant in the GMM method. The change of direction of the relationship also occurs in boards consisting of at least thirty (ACM30) and forty (ACM40) percent female directors. However, the relationships remain insignificant. These results suggest that the biased parameter estimates in the OLS estimations are due to simultaneity, unobserved heterogeneity and the dynamic relationship between board gender diversity and company performance. This indicates that the OLS method leads to the reporting of a spurious causal relationship.

In addition to the reverse sign of the relationship between board gender diversity and company financial performance in the dynamic GMM estimations, the magnitude of the correlations has increased from boards consisting of at least twenty percent (ACM20) to thirty percent (ACM30), and further increased in boards with forty percent (ACM40) female directors. We posit that the increment of female directors on boards may improve company performance; despite the insignificant correlations which could be the results of low female board representation as presented in descriptive analysis. Only 5.5% of the observations consist at least thirty percent (ACM30) female board representation and 2% observations consist forty percent (ACM40) female directors. This argument is in line with Marinova et al. (2016) and Joecks et al. (2013) , suggesting that the

insignificant correlation of board gender diversity and company financial performance is affected by overall low female board representation that invalidates the results.

Extending Kanter's critical mass (1977b) classification in board gender diversity analysis, we posit that the relationship between board gender diversity and company financial performance could be non-linear. This is because the insignificant positive correlation of boards with all male directors (K1) turns to a negative correlation in the skewed boards (K2), indicating that there is a possibility of tokenism in boards with only one or two female directors that lead to the negative impacts on company financial performance. However, this negative correlation has reversed to positively correlated in the tilted boards (K3) and more so in the balanced boards (K4). The magnitude of the positive correlation in the balanced boards (K4) is higher than boards with all male directors (K1), suggesting that the positive impact of the balanced boards is greater than all male boards on company financial performance. We posit that the relationship between gender-diverse boards and company financial performance could be non-linear; despite the insignificant correlations which could be the results of low female board representation on boards as presented in the descriptive analysis.

Figure 4.3 demonstrates that the relationship between the proportion of female directors on boards and company financial performance is non-linear and follows a U-shaped curvilinear relationship based on the sample of this study. The results of Kanter's critical mass classification also reveals that the tipping point for female directors to make a positive contribution on company financial performance is when there are at least twenty percent female directors on boards. This impact is of greater magnitude when females board representation reaches at least thirty percent representation. We are unable to draw conclusive findings on the non-linear relationship and the exact tipping point of female board representation due to the insignificant results.

Figure 4.3: Correlation Between The Proportion Of Female Directors On Boards And Company Performance Based On Kanter's Critical Mass

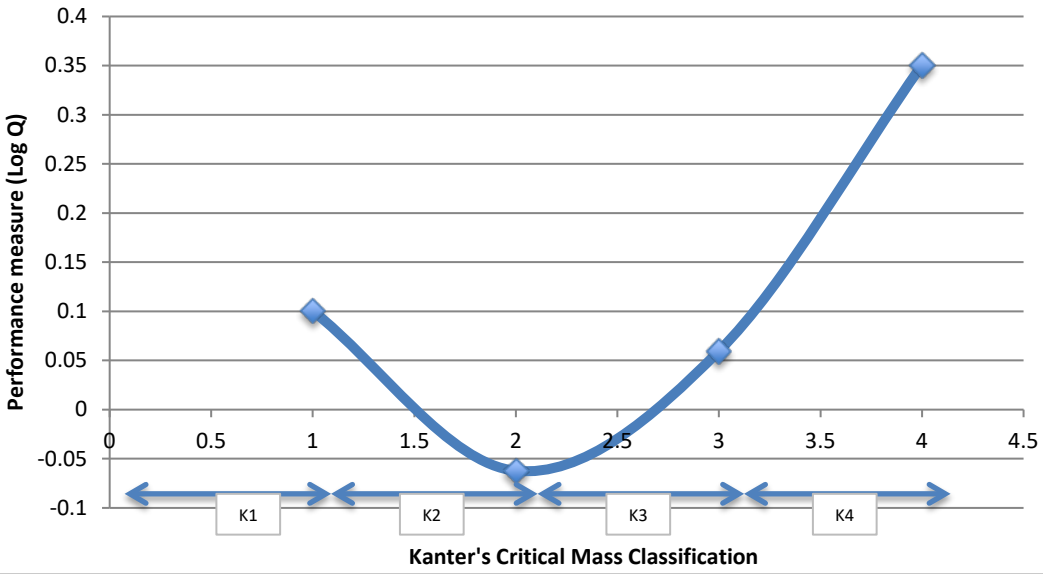


Figure 4.3 presents the relationship between board gender diversity and company financial performance based on critical mass classification [32]. It indicates that boards with all male directors (K1) are positively correlated with company performance. However, this positive correlation turns into negatively correlated with company financial performance in boards comprise of at least one female director on boards but not more than twenty percent of female directors (K2). The figure shows that female directors only contribute positively to company financial performance when there is at least twenty percent of female directors on boards, which are the tilted and the balanced boards (K3 and K4). This contrasts with the expectation of a positive linear relationship between female participation and company financial performance.

[32] K1 (Uniform boards) equals one when the board consists of all male directors and zero otherwise; K2 (Skewed boards) equals one when there is at least one female director but less than twenty percent female directors on boards, and zero otherwise; K3 (Tilted boards) equals one when there is at least twenty percent but not more than forty percent of female directors on boards, and zero otherwise; K4 (Balanced boards) equals one when there are at least forty percent of female directors on boards, and zero otherwise.

Chapter 5: Conclusions, Contributions, Implications and Limitations

5.1 Introduction

This study examines the relationship between gender-diverse boards and company financial performance by addressing the most serious endogeneity concerns in diversity-performance studies. The existing theoretical frameworks that relate to board gender diversity do not give a clear prediction between board gender diversity and company performance. Our intuitive belief is there are positive impacts from gender-diverse boards on company overall performance. The theoretical framework of gender diversity can be observed as both having positive or negative implications. As yet we have no complete understanding on how, why and when board gender diversity affects board processes and outcomes that lead to overall company performance. The main issue of corporate governance characteristics and performance studies is the presence of endogeneity that undermines causal inference. This study addresses the endogeneity issues from applying the most up-to-date econometric methods with an improved and novel external instrumental variable that is both relevant and valid. However we are unable to explain the logic and direction of the variable interactions.

This chapter presents the conclusion of this study and the summary discussions between board gender diversity and company performance. The results of the study are highlighted to demonstrate the contributions for this area of research. We also discuss the implications of this study from the methodological, theoretical and practical aspects. The final section presents the limitations of this study and provides suggestions for future research on board gender diversity and company performance.

5.2 The Conclusions On Board Gender Diversity And Company Financial Performance

Larcker and Rusticus (2010) argue that theory development is critical, but on the other hand theory is never likely to be a complete solution (Van Lent, 2007). Given the complexity in determining the causal relationship in governance and performance studies; Gippel, Smith and Zhu (2015) suggest that researchers to look beyond the textbook solutions by utilising a natural experiment method in studying the causal relationship of the interested variables. Although this is an excellent suggestion, it can be very challenging in the corporate board setting. This suggests that unless there is a comprehensive theoretical framework that explains and predicts the relationship between gender-diverse boards and company there is a necessity for continued empirical research in this area.

The current economic models in the literature are insufficient to capture the complexity of human interactions and the dynamics of group processes, especially in a corporate board context. The difficulty in developing a comprehensive model is that many variables both company specific and external to company that may influence the company financial performance and its choice of directors. If the relationship between gender-diverse boards and company financial performance is due to omitted variables or only partially explained by the variable of interest, being female representation on boards, then the endogeneity issue may exist. In this case, the coefficient of the proportion of female directors on boards (PFOB) cannot be interpreted in the simple correlation manner. The coefficient of PFOB has no meaning in explaining company financial performance, and the magnitude of the relationship, as well as the direction of the relationship, can be misinterpreted. It is impossible to determine the endogenous relationship between board gender diversity with the application of simple economic models, more specifically, using the principal-agent models to determine the concept of board gender diversity (Rose, 2007).

To address the endogeneity issue that has plagued the governance-performance research, this study provides a comparative detailed analysis of various econometric estimations and methods. We conclude that the endogeneity concern in board gender diversity and company financial performance studies lies in three factors. First, there exists a simultaneous or causal relationship between the proportion of female directors on boards and other board structures and company financial performance measures. Second, the endogeneity may exist due to unobserved company-level heterogeneity that influences company financial performance but is not specified in the model specification. Third, the dynamic endogeneity of past performance measure (Tobin's Q at t-1) need to be incorporated on the governance structure in the dynamic GMM specification. We conclude that the major sources of endogeneity are caused by all three possibilities of simultaneous causality, unobserved heterogeneity and the dynamic relationship of past performance of this study.

Our results suggest that the presence of female directors on boards has no significant impact on company performance, as measured by Tobin's Q. At the same time, female board representation does not exhibit any negative implications for company performance. The subsequent analysis based on the critical mass of female directors indicates that there is no significant impact of the different groupings of female directors on company performance. The results reveal that boards with all male directors do not perform better than gender-diverse boards. While the coefficients of boards with at least thirty percent and forty percent of female directors report a greater positive magnitude than boards with all male directors to company financial performance, although the results is not significant.

The results of this study highlight that we do not know the exact relationship between gender-diverse boards and company financial performance. The hypotheses of this study were based on the conceptual framework as discussed in chapter two that links board gender diversity and company financial performance. The positive implications of gender-diverse boards as supported by the resource dependence theory and the human capital theory may have been offset by the

other theories. The negative impact of over-monitoring of gender-diverse boards in agency theory and compromising of group effectiveness due to group conflict may have nullified the value of female contributions, such as innovations and creativity, diverse perspectives and knowledge. A possible explanation of the insignificant relationship we observe in this study between board gender diversity and company financial performance may come from contingency theory (Fiedler, 1968; Lawrence & Lorsch, 1967) . This theory suggests that under different circumstances and different organisation structures, there exists a complex relationship between board gender diversity and company performance. For some companies, board gender diversity may enhance company value due to the diverse perspectives and knowledge gained from the different backgrounds of directors. For some the diversity of opinions and conflict within the board structure may adversely affect company value. It should be noted that the overall female representation on boards of this study is relatively low, with forty-three percent of the firm-year observations having no female directors on boards. Boards with at least thirty and forty percent of female directors remain low over the entire study period. This could be the possible reason that invalidates the significant positive correlation between board gender diversity and company financial performance as suggested by Marinova et al. (2016) and Joecks et al. (2013) . As previously noted, the relationship between board gender diversity and company financial performance is endogenously determined. This results in simultaneous causality, unobserved heterogeneity and the dynamic relationship between past performances on current board structure. Supporting that dynamic estimation with instrumental variable method tends to find no correlation between board structure and company financial performance (Gippel et al., 2015).

5.3 Contributions And Implications

The main contribution of this study is to highlight the importance of addressing the endogeneity issues existing in board gender diversity and company financial performance studies. Using various econometric estimation methods, this study illustrates that both the OLS random effects and fixed effects estimations, based on the strict exogeneity assumptions, produce a spurious correlation between

board gender diversity and company financial performance. While the 2SLS instrumental variable method is able to remove the confounding effects of board gender diversity and company performance, it is not robust enough to account for the dynamic nature of board structure and company performance. Once we apply the dynamic GMM estimation that is robust to all forms of endogeneity concerns and well-specified based on Hansen test of over-identifying restrictions and the Arellano-Bond test of auto-correlation, the results demonstrate that not only do the spurious negative correlation as suggested with the OLS estimations disappear, the sign reverse from negative to positive. This key finding suggests that we cannot draw any inference from any specifications that do not address the endogeneity issues in board gender diversity and company financial performance studies.

Another significant contribution of this study is the introduction of a novel external instrumental variable that is relevant to female board representation. We believe that the institutional environment co-evolves with corporate gender policies and the geographical influence of local female councillors transpose the experienced female executives to excel to the leadership level of corporate boards. This study provides both theoretical support and statistical tests in the selection of the novel external instrument variable of this study, the proportion of local female councillors. The theory of economic ramification of distance as suggested by Bouwman (2012) and the influence of political science in corporate governance by Terjesen et al. (2015) supports the selection of the external instrumental variable. More importantly, this external instrumental variable fulfils both the relevancy and exogeneity tests to confirm the validity of the instrumental variable.

The results of this study reveal that board gender diversity has no significant impact on company financial performance in the Australian public listed company's context. However, the results also do not reveal any adverse impact on company financial performance for the increment of female board representation. Despite the insignificant findings of this study, we believe that this study has some implications for methodological, theoretical and practical aspects.

From the methodological perspective, this study shows that the relationship between gender-diverse boards and company financial performance is complicated due to the endogenous relationship. This study applies various econometric techniques and demonstrates the importance of addressing the endogeneity concerns in board gender diversity and company financial performance studies. This allows this study to explicitly recognises all three sources of endogeneity that lead to biased estimates of how board gender diversity affects company performance. Unobservable heterogeneity arises when there are unobservable company-level or board-level characteristics that affect both the board gender diversity policy or company performance. Simultaneity arises when board gender diversity is the function of company financial performance or vice versa. Dynamic endogeneity arises due to the relationship between company current performance that affects board gender diversity policy, which will in turn also affect company future performance. The application of the more advanced and appropriate dynamic GMM estimation used in this study is well specified to all specification tests. It also demonstrates that board gender diversity is not exogenous and not a determinant of company performance. This suggests that the negative significant relationship between board gender diversity and company financial performance as indicated in the OLS estimations may be spurious and unreliable. In contrast, dynamic estimation with instrumental variable method tends to yield insignificant and no relationship between board gender diversity and company financial performance(Gippel et al., 2015). The comparative analysis using various econometric methods demonstrates that using econometric estimations that do not deal with endogeneity issues in board gender diversity and company financial performance studies may produce biased findings and suggest a spurious correlation.

From the theoretical perspective, this study recognises the importance of gender-diverse boards by referring to resource dependence theory and human capital theory. These two theories suggest that female directors with different perspectives, skills, knowledge, experiences and backgrounds contribute to board

dynamics, decision-making process and ultimately company financial performance. This study recognises the possibility of negative impacts of board gender diversity on company financial performance due to agency conflicts of over-monitoring as suggested by Adams and Ferreira (2009). The overall low female representation on boards could be the possible reason that invalidates the significant positive correlation between board gender diversity and company financial performance as suggested by Marinova et al. (2016) and Joecks et al. (2013) . This study also demonstrates that the relationship between board gender diversity and company financial performance could be non-linear based on Kanter's critical mass theory. The further break down of the proportion of female directors on boards based on critical mass classification indicates that the relationship of board gender diversity and company financial performance follows a U-shape curvilinear correlation[33]. This supports the initial argument of this study that proposes a non-linear relationship between gender-diverse boards and company performance. Further, this study also posits that the incremental positive impacts of female board representation on company financial performance may eventually achieve the optimal level and at some point further increased female participation may become value decreasing as male participation decreases and the benefits of diversity are diminished. Figure 5.1 illustrates the prediction of the relationship between board gender diversity and company financial performance once the board gender diversity structure goes beyond its optimal level.

[33] Refer Figure 4.3 for the non-linear correlation between board gender diversity and company financial performancebased on Kanter's critical mass classification.

Figure 5.1: Prediction of Non-linear Relationship Between Board Gender Diversity and Company Financial Performance at the Optimal and beyond Optimal Level

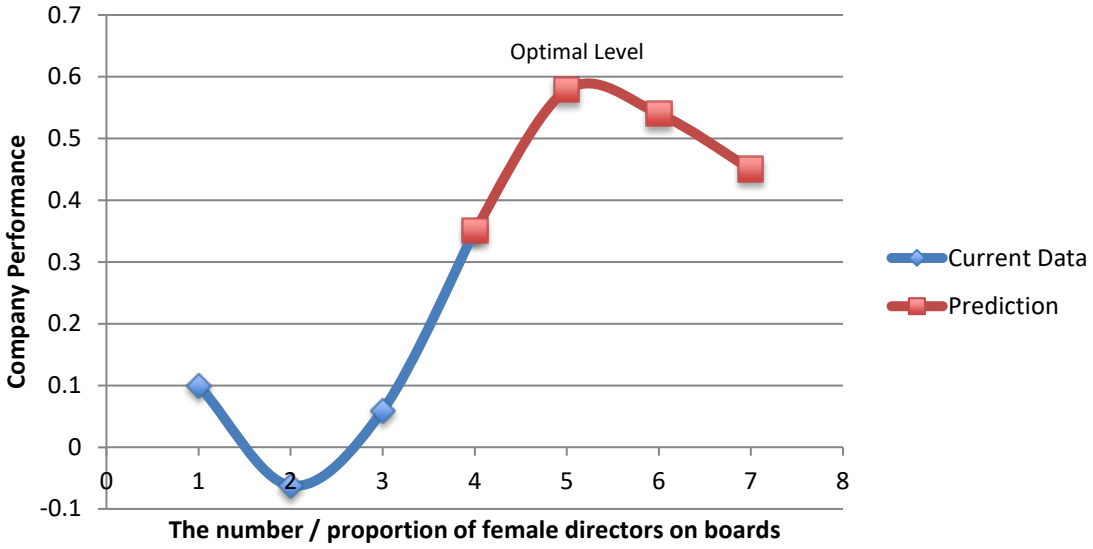


Figure 5.1 illustrates the prediction of the non-linear relationship between board gender diversity and company financial performance. The sample data of this study does not have any observations that go beyond the balanced boards classification, which is boards with more than sixty percent of female directors. Hence, we can only provide a prediction of the relationship based on Demsetz's (1983) theory of firm and economic theory. This study argues that logically the relationship between gender-diverse boards and company financial performance should be non-linear. The positive impact of female board representation upon is achieved at the minimum tipping point of at least twenty percent of female directors. The positive relationship between gender-diverse boards and company financial performance will eventually achieve the optimal level. Beyond this optimal level of board gender diversity structure, the increased of female participation may become value decreasing as male participation decreases and the benefits of diversity are diminished.

The practical implication of increasing female board representation is evidenced in the intervention of government policy. This is either by way of hard law to legislate board gender quotas or the soft approach using "comply or explain" gender

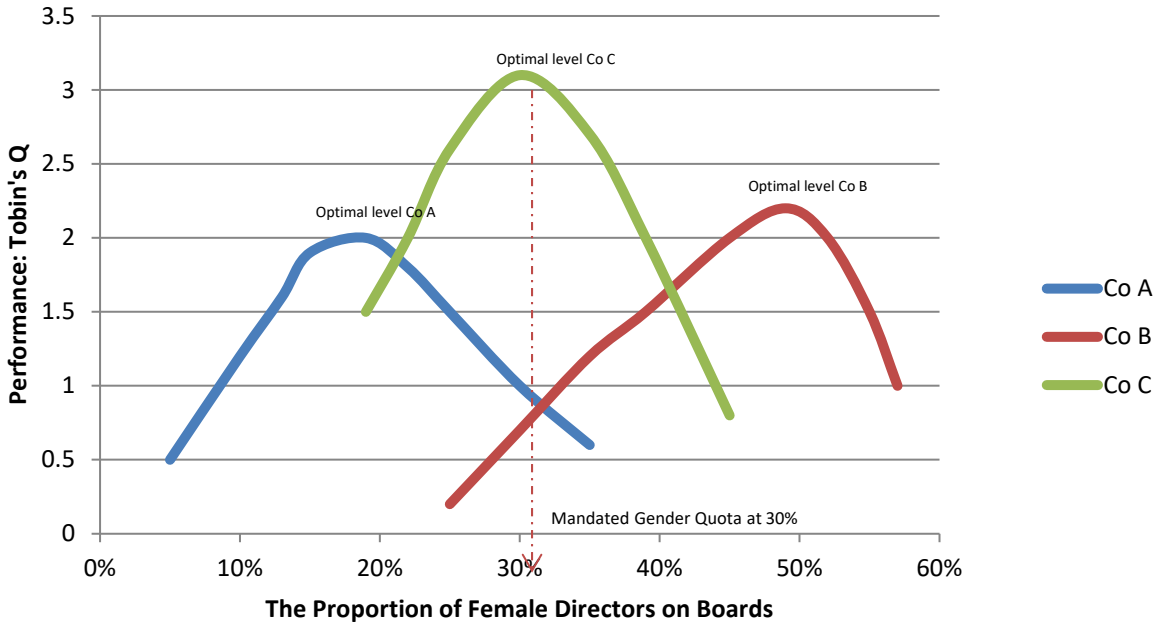
diversity recommendations. Generally, counties with mandatory gender quotas[34] seem to have more gender-diverse boards while countries with diversity compliance provisions[35] tend to have lower female representation on boards (Azar, Martens, Popolis, & Sancho, 2017) . In the absence of the hard law and soft law, countries that are resistant to adopting any regulations are lacking behind in promoting female board representation[36]. It is obvious that mandating minimum gender quotas is an effective way to advance female participation at the board level. However, the absence of a significant positive relationship between gender-diverse boards and company financial performance of this study does not provide support for the initiative to impose gender quotas in the public listed companies based on economic argument. This is based on the contingency theory (Fiedler, 1968; Lawrence & Lorsch, 1967) argument where each company's internal optimal equilibrium differs from others, and each company chooses the governance structure that maximise their value. In this instance, implementing gender quotas may lead to adverse effects on company value and performance. Figure 5.2 illustrates the scenario where mandating gender quotas may lead to companies operate at a sub-optimal level.

[34] Countries wit mandating gender quotas are Norway, Germany, Belgium, Italy, France, the Netherland, Spain, Malaysia and India.

[35] Countries with diversity compliance provision are the U.K., Australia, Denmark, Finland, Sweden, Austria, and Switzerland.

[36] Countries with no gender diversity regulations and with low female representation on boards are China, Russia, Greece, South Korea and Japan.

Figure 5.2: Comparison of Companies at Internal Equlibrium of Board Gender Diversity and Company Performance Relationship



Source: Gippel, Smith & Zhu (2015)

With reference to the graphic example as shown in Gippel et al. (2015), this study replicates the concept of company internal optimisation of insider ownership and performance relation as shown in Figure 5.2 using gender quotas and company financial performance relationship. The graphic presents three companies with different internal equilibrium points between board gender diversity and company performance. Company A optimises its board gender diversity and performance at about 22%, while companies B and C' s internal equilibrium is achieved at 30% and 48% level respectively. If gender quotas is legislated at the thirty percent level, company A is forced to increase the proportion female directors beyond its optimal level of 22%, while company B is forced to reduce the proportion of female directors and no longer remain at its optimal level of 48%. In this instance, only company C is at an equilibrium optimal level that satisfies the gender quotas requirement. This shows that each company operates under different circumstances with different organisation structure that has its performance maximising governance choice. Therefore, company should choose board gender diversity structure that maximise the talent of the directors to enhance the

company value and its objectives. In this sense, mandating gender quotas can be detrimental to company financial performance where company A and B are at their sub-optimal performance level.

If mandating board gender quotas can be detrimental to company and may lead to sub-optimal performance level, gender quotas legislation on corporate board should be motivated by other reasons. For example, social norms and community culture are the crucial factors that influence the acceptance of female leadership/directorship role. The real change in social norms and attitudes towards female leadership or directorship is fundamentally crucial to promote female representation on boards in some jurisdictions, for example Norway and Germany. However, it is not reflected in most of the Nordic countries. Sweden and Finland have no mandatory law that governs the regulatory framework of gender quotas, but both countries have a relatively high female board participation in the world. On the other hand, in countries where there are mandated regulation to govern the gender policy, female directors are only being appointed to fulfil the mandated requirement. For example, India's regulatory framework requires a gender quota of at least one female director on boards and Malaysian's public listed companies are required to have thirty percent of female directors. Under this legislation, companies that are subjected to the law have no other choice but to appoint female directors on boards to fulfil the minimum law requirements. This can lead to appointment based on celebrity status or family relationships and not on the ability and qualifications.

In the Australian current climate, there is increasing demand for corporate boards' responsibility and board of directors are facing with increasing due diligent checks. As the corporate governance roles shift from shareholders centric to stakeholder focus, the topic of board gender diversity is more relevant as females have different perspectives, knowledge and life practices relative to males. It is logical to expect board diversity becomes more socially compelling and may add values to the company. Australian social norms imply that it is the right thing to do in achieving equality and giving female an equal chance of participating on corporate

boards. It is also unethical to deny access to potential and capable females onto corporate boards solely based on gender. Furthermore, excluding a segment of society talent due to gender may lead to suboptimal board composition. As the findings of this study do not find any adverse effect of board gender diversity, this study supports the argument for improvement of female representation on boards based on social and moral justifications. However, as shown in Figure 5.2, forcing companies to comply with legislative gender quotas under the pressure of the authorities may be costly, and in some cases, it may alter the optimal board structure. Therefore, the soft approach with gender diversity recommendations is more desirable on the assumption that companies choose their optimal board structure and the characteristics of the directors to suit the company structure.

5.4 Limitations And Suggestions For Improvement Of Future Studies

Like all other studies, this study does have several limitations like all other studies. These limitations have implications and provide some avenues for future research for interpreting the findings. First, the sample is based on the ASX200 companies listed, which impact the external validity of the findings. In addition, by comparison with other countries, the Australian market is smaller relative to the U.S., the U.K. and other European countries. There are also differences between Australian market and other nations in legislation, corporate governance system, cultural backgrounds; board structure and gender diversity practice. To address the external validity concerns, studies based on multi-country or meta-analysis of several countries are needed. In the Australian context, the sample is not randomly selected from the top two hundred largest publicly listed companies, excluding companies in the financial sector. This may suffer from sample selection bias that hinders the generalisation of the results to all companies across Australia. This is a limitation shared with most governance studies.

Second, the diversity measure of this study was based on gender. There are other dimensions of diversity that need to be explored and may be beneficial to the board structure. For example ethnicity, age, backgrounds and education attainment of directors may be just as important to boards composition and

relevant to the current global economy setting. Future studies might integrate these diversity dimensions and be more relevant to the mainstream society. In addition, as this study also applies the critical mass theory in gender groupings, future studies might explore the critical mass theory based on other diversity aspects.

Third, Tobin's Q has shortcoming as a performance measure. Other performance measures that may be equally used are market performance (such as market-to-book value and stock liquidity), accounting measures (e.g., return on equity, return on assets, profitability, earning quality, etc.) and operational performance (e.g., customer satisfactory and service, productivity time spam, delivery time). This study's conceptual framework indicates that board gender diversity also contributes to other non-economic aspects such as sustainable environmental practices, social impacts, corporate social responsibility, board dynamic and processes, transparency and accountability of financial reporting, innovation and creativity. Future studies might explore other areas that link board gender diversity to other aspects that could be beneficial to the company as well as society as a whole, rather than the narrow measure of economic outcomes. Furthermore, the results from these other dimensions could be the moderating or mediating effects on the performance measure.

5.5 Final Remarks

The major contribution of this study is its contribution to the endogeneity concerns in diversity-performance studies. We discuss the theory behind each econometric technique and explain why the dynamic GMM estimation is the appropriate method in examining board gender diversity and performance studies. Because there are different sources of endogeneity between board gender diversity and company performance, this study shows the advantages of applying the dynamic GMM method over the OLS fixed effects and the 2SLS estimations. These endogeneity concerns lead to spurious negative correlation between board gender diversity and company financial performance in the OLS estimations. The results of this study based on the dynamic GMM estimations conclude that there is no

causal relationship between board gender diversity or other board characteristics and company performance. This indicates that previous studies that ignore any of the three sources of endogeneity between board gender diversity and company financial performance may lead to bias estimates.

Given the findings and the fact that the world is made up of an almost equal proportion of the male and female population, having equal representation of each gender should be a common sense in all aspects of a business establishment. However, females are under-represented in the corporate boards of almost all public listed companies in the world. It is important for companies to commit to equal opportunity with the conventional wisdom of gender diversity is a good thing to do. Board gender diversity is also the right thing to do in achieving equality and giving experienced and skilled females an equal chance of participating on corporate boards. The appointment of female directors on boards should base on merit and fairness rather than economic outcomes. The absent of significant positive correlation between gender-diverse boards and company financial performance of this study does not imply that gender diversity on corporate boards is less desirable. On the other hand, upon addressing the endogeneity concern in this study, the presence of female directors on boards also does not lead to negative impact on company performance. Hence, this study supports both societal moral justification and economic justification to improve female representation on corporate boards.

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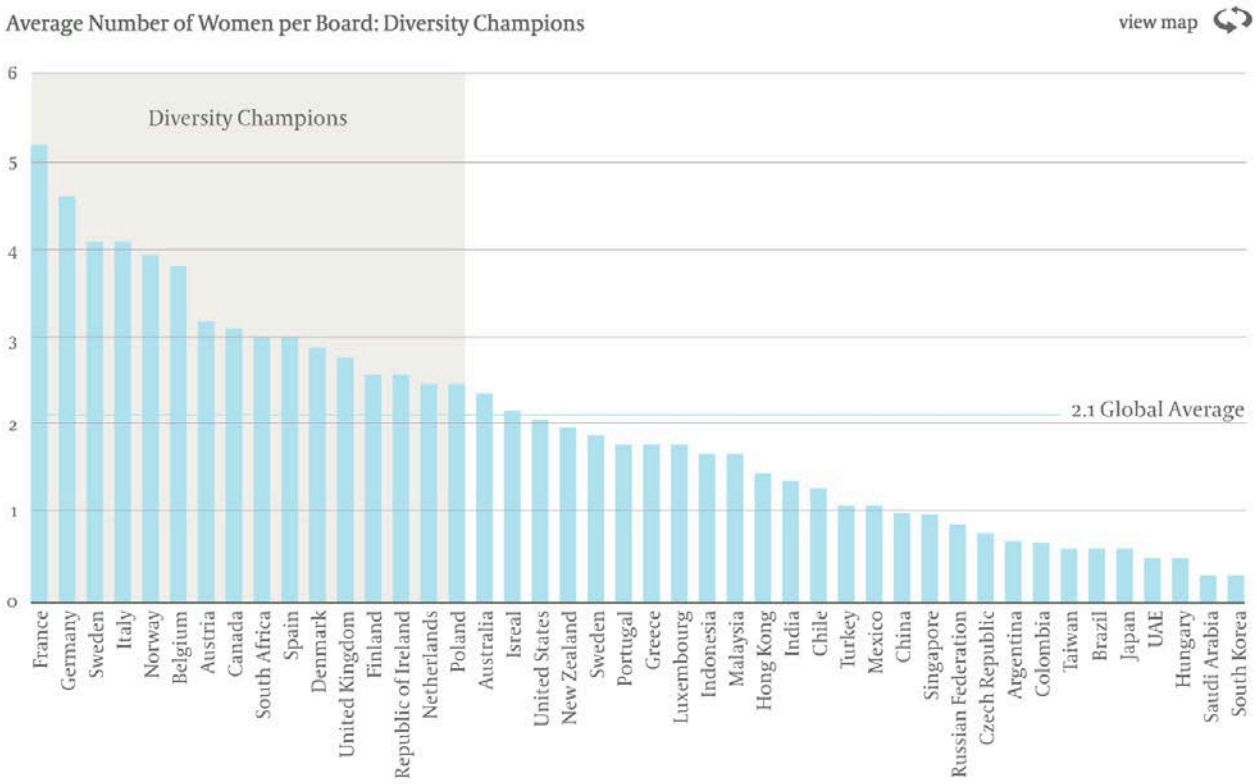
Appendices

Appendix 1: Boardroom Gender Quota Laws And Corporate Governance Recommendations By Country[37]

Country	Passage Year	Requirement type	Compliance Year	Provision of gender diversity Code
Norway	2003	40%	2008	
Spain	2007	40%	2015	
Iceland	2010	40%	2013	
Finland	2005	At least 1 female director	2010	
France	2011	40%	2017	
Belgium	2011	33%	2017	
Netherlands	2011	30%	2013	
Germany	2015	30%	2016	
Italy	2011	33%	2015	
Canada	2006	50%	2011	
Israel	2007	50%	2010	
India	2013	At least 1 female director	2015	
Malaysia	2013	30%	2016	
Sweden				2004
U.K.				2010
Denmark				2005
Luxembourg				2009
Australia				2010
U.S.A.				2009
Austria				2010
Poland				2010

[37] Source: Catalyst – Legislative Board Diversity. http://www.catalyst.org/legislative-board-diversity

Appendix 2: Global Board Gender Diversity Report



Source: 2016 Global Board Diversity Analysis – EgonZehnder. Extract from https://www.egonzehnder.com/gbda

Appendix 3: Six Gender Equality Indicators According To The Workplace Gender Equality Act (2012)

GEI 1: gender composition of the workplace

GEI 2: gender composition of governing bodies of relevant employers

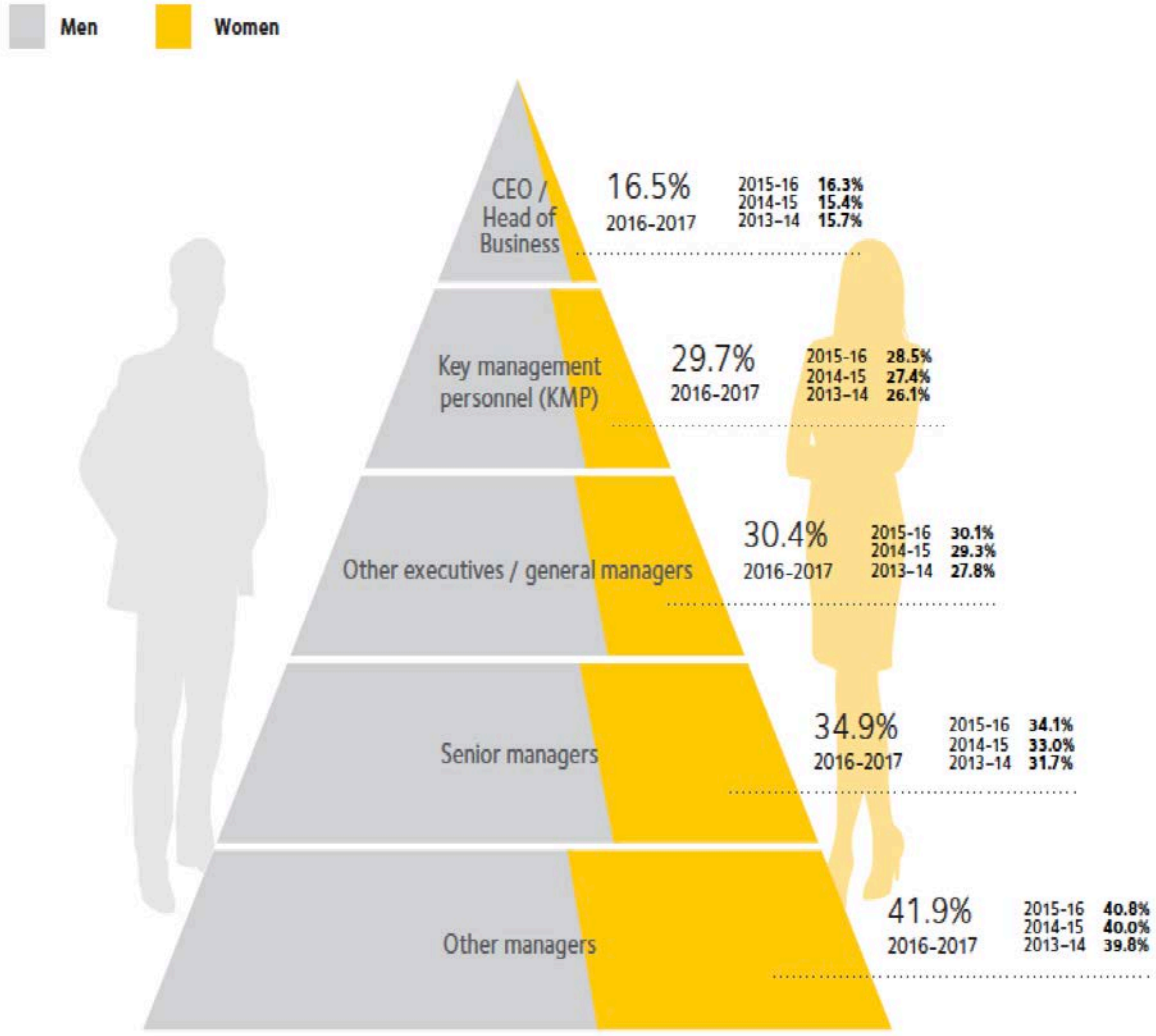
GEI 3: equal remuneration between women and men

GEI 4: availability and utility of employment terms, conditions and practices relating to flexible working arrangements for employees and to working arrangements supporting employees with family or caring responsibilities

GEI 5: consultation with employees on issue concerning gender equality in the workplace

GEI 6: sex-based harassment and discrimination.

Appendix 4: Females In leadership



Source: Workplace Gender Equality Agency – Australia's gender equality scorecard (Novermber 2017).
Extract from: https://www.wgea.gov.au/fact-sheets-and-research-reports/fact-sheets-and-statistics

Appendix 5: Extract Of The Australian Stock Exchange Corporate Governance Council's Diversity Recommendations: Principle 3

Principle 3 - Recommendation 3.2

"Companies should establish a diversity policy and disclose the policy or a summary of that policy. The policy should include requirements for the board to establish measurable objectives for achieving gender diversity and for the board to assess annually both the objectives and progress in achieving them."

Principle 3 - Recommendation 3.3

"Entities should disclose in each annual report the measurable objectives for achieving gender diversity set by the board in accordance with the diversity policy and progress towards achieving them."

Principle 3 - Recommendation 3.4

"Entities should disclose in each annual report the proportion of:

- women employees in the whole organisation
- women in senior executive positions, and
- women on the board"

Principle 3 - Recommendation 3.5

"The diversity policy or a summary of its main provisions should be made publicly available, ideally by posting it to the company's web site in a clearly marked corporate governance section."

Appendix 6: Extract Of The Australian Stock Exchange Corporate Governance Council's Diversity Recommendations: Principle 1

Principle 1 - Recommendation 1.5

A listed entity should:

(a) Gave a diversity policy which includes requirements for the board:

1) to set measureable objectives for achieving gender diversity; and
2) to assess annually both the objectives and the entity's progress in achieving them.

(b) Disclose that policy or a summary of it; and

(c) Disclose as at the end of each reporting period:

1) the measureable objectives for achieving gender diversity set by the board in accordance with the entity's diversity policy and it's progress towards achieving them; and
2) either:
    A. the respective proportions of men and women on the boards, in senior executive positions and across the whole organization (including how the entity has defined "senior executive" for these purpose); or
    B. the entity's " Gender Equality Indicators", as defined in the Workplace Gender Equality Act 2012[38].

[38] The Workplace Gender Equality Act 2012 applies to non-public sector employers with 100 or more employees in Australia. The act requires such employers to make annual filings with the Workplace Gender Equality Agency disclosing their "Gender Equality Indicators".
For those entities which choose to follow recommendation 1.5(c)(2)(B) and publish their "Gender Equality Indicators" in preference to the statistics on diversity mentioned in recommendation 1.5(c)(2)(A), publication of their "Gender Equality Indicators" by the Workplace Gender Equality Agency on its website will be taken to meet the recommendation.

Appendix 7: Extract Of The Australian Human Rights Commission's Recommendations On Gender Diversity And Equality – June 2010.

Overall Recommendations

The *Gender Equality Blueprint 2010* sets out recommendations in five priority areas which significantly affect both the public and private lives of women and men:

- Balancing paid work and family and caring responsibilities
- Ensuring women's lifetime economic security
- Promoting women in leadership
- Preventing violence against women and sexual harassment
- Strengthening national gender equality laws, agencies and monitoring

Recommendation 7

To strengthen the representation of women at decision-making levels:

- a minimum target of 40% representation of each gender on all Australian Government Boards within three years should be set, publicly announced and progress should be reported annually
- a minimum gender equality target in the Senior Executive Service in the Australian Public Service should be set, publicly announced and progress should be reported annually
- all publicly listed companies providing goods or services to the Australian Government should be certified by the Equal Opportunity in the Workplace Agency
- a target of 40% representation of each gender on all publically listed boards in Australia, to be achieved over five years should be promoted. If progress is not made, the Australian Government should consider legislating to require publicly listed companies and other large employers to achieve a mandatory gender diversity quota of a minimum of 40% of both genders within a specified timeframe, failing which penalties will be imposed.

Appendix 8(a): Studies with the Australian Sample in relation to Board Gender Diversity and Performance.

Author/(s)	Journal	Study Period	Findings	Methodology
Ali, Kulik & Metz (2011)	The Int'l Jr of Human Resource Management	2001-2007	Boardroom gender diversity and performance relationship is inverted U-Shaped curvilinear based on integration of resource based views and self-categorisation & social identity theories	Hierarchical Multiple regression
Ali, Ng & Kulik (2014)	Jr of Business Ethics	2011-2012	Boardroom gender diversity and performance relationship is inverted U-Shaped curvilinear based on integration of resource based views and self-categorisation & social identity theories	Hierarchical Multiple regression
Bonn (2004)	Journal of the Australia and New Zealand Academy and Management	1999 for 2003	Outsider ratio and female directors ratio were positively associated with firm performance. Board size and directors' age had no influence on firm performance. 1999 Ind var with 2003 Dep Var for 4 year-time lag	OLS
Chapple & Humprey (2014)	Journal of Business Ethics	2004-2011	Boards with at least 1FOB are less likely to receive a going concern opinion. No correlation between having multiple WOB and performance.	Logistic Regression
Nguyen & Faff (2007)	Corporate Ownership & Control	2000-2001	Gender diversity promotes shareholder's value and positively associated with firm value	OLS
Strydom, Au Yong & Rankin (2017)	Australian Jr of Management	2005-2013	Tilted & Balanced boards have higher earning quality than all male and skewed boards. Critical mass is achieved at 30% FOB. Relationship of GD and earnings quality is U-shaped.	OLS, Cluster Ses & 2-step treatment effect model
Wang & Cliff (2009)	Pacific Accountng Reviews	2003	Gender diversity-no association with return (ROA, ROE). Gender and racial diversity do not have significant influence on performance. Greater diversity does not lead to poor performance; suggest that gender and racial diversity could be achieved without a negative effect on shareholder wealth.	OLS

Appendix 8(b): Studies With The Australian Sample With Other Corporate Governance Measures

Author/(s)	Journal	Study Period	Findings	Methodology
Ahmed & Ali (2017)	Jr of Contemporary Accounting & Economics	2008-2013	Gender diversity - Positive with stock liquidity. Reject token women and support critical mass theory.	Pooled OLS (Main), 2SLS (using gender reform as IV) and propensity score matching (PSM) to address endogeneity.
Capezio & Mavisakalyan (2016)	Australian Jr of Management	2002-2007	Gender diversity - associated with decreased probability in fraud. No evidence of endogeneity, suggest unobserved confounding variables is not robust	Probit Regression, IV: CEO's first name femininity as proxy for gender awareness issues
Christensen, Kent & Stewart (2010)	Australian Accounting Review	2004	Board Characteristics: Board Independence has a negative impact on ROA & Q. CEO dua & large Board size has negative impact on ROA but enhance Q. Meeting frequency has no significant on ROA but negatively related to Q.	
Kiel & Nicholson (2003)	Board Composition & Corporate Performance	1996	Board Characteristics: Board size is positively correlated to firm value; proportion of inside director is positive to market-based performance	ANOVA, OLS
Monem	Working Paper: Journal of Contemporary Accounting and Economics		Determinants of Board Structure: Board size and board independence are increasing in firm size; CEO duality decrease in firm size. High ownership concentration increase board size, decrease board independence and increase CEO duality.	OLS, Binary logistic regression
Nadeem, Zaman & Saleem (2017)	Journal of Cleaner Production	2010-2014	Significant positive relationship between WOB and corporate sustainability practices.	Dynamic GMM. Static OLS & FE are not robust.
Pham, Suchard & Zein (2011)	Australian Jr of Management	1994-2003	Do not find a significant relationship between performance (Q & EVA) and corporate governance measures (board independence and size, insider & outsider shareholdings)	OLS, FE, GMM

Appendix 8(b): Studies With The Australian Sample With Other Corporate Governance Measures (Continued)

Author/(s)	Journal	Study Period	Findings	Methodology
Richardson, Taylor & Lanis (2016)	Accounting Research Jr	2006-2010	Gender diversity reduces the likelihood of tax aggressiveness	Probit Regression Analysis, 2-stage Heckman procedures
Schultz, Tan & Walsh (2010)	Australian Jr of Management	2000-2007	No significant relationship between corporate governance variable and performance	GMM
Sheridan, Ross-Smith, & Lord (2014)	Equality, Diversity and Inclusion: An International Journal	2009-2012	Descriptive study: Draw attention to how the organisational factors may be shaped by changing institutional rules	-
Sinclair (2013)	Melbourne Business School		Descriptive study: Examine the construct of leadership in Australia's women leaders.	-
Spender (2012)	Australian Journal of Corporate Law		A review of quotas discussion and implementation	-
Wang & Oliver (2009)	Accounting Research Journal	2003-2006	Board Composition: Negative impact of executive directors on subsequent risk; Affiliate and independent directors have no significant effect on the level of performance variance; Block-holders give a positive influence of firm risk; Companies with poor dividend payout or low managerial shareholdings tend to be riskier.	

Appendix 9: Financial Variables And Definition (Morningstar DatAnalysis Premium)

Financial Variables	Definition
Return on Equity (ROE)	Net profit after tax before abnormal / (shareholders equity - outside equity interests). ROE is an evaluation of profit earned in relation to equity resources invested (the viewpoint of equity holders). It is calculated by dividing net profit before abnormal by shareholders equity. In the cases where shareholders equity is less than zero, we have set the value of ROE to null. Return on Equity is a key indication of the company's performance as it provides information on how well managers are employing funds invested by the shareholders to generate returns. Long run value of a company can be determined by the relationship between ROE and the cost of equity capital. ROE is affected by two factors, how profitability the company employs assets and the size of the firm's asset base relative to the shareholder's investment.
Return on Assets (ROA)	[Net Income + Interest Expense*(1-Corporate Tax Rate)]/[Total Assets - Outside Equity Interests]. ROA is a key measure of a company's profitability, equal to a fiscal year's earnings divided by its total assets. Return on assets essentially shows how much profit a company is making on the assets used in its business.
Net Gearing	(Short term debt + long term debt - cash) / shareholders equity
Gross Gearing	(Short term debt + long term debt) / shareholders equity
Market Capitalisation ($m)	The market value of the company's equity capital. This is calculated by multiplying the number of common shares by the current price. Other classes of equity such as preference shares are normally not included. Closing share price on the last day of the company's financial year * number of shares outstanding at the end of the period
Total Assets	The total (current and non-current) assets as reported in the annual report.
Total Liabilities	Total current and non-current Liabilities.
Total Revenue	Total revenue excluding interest income.

Appendix 10: SIRCA's Board Of Directors And Corporate Governance Variables And Definition

Description	Definition
Chairman	The person is the chairman of the board of directors at the balance date.
CEO	The director is the chief executive officer of the company at the balance date.
CEO tenure YTD	The number of years that a person has been the CEO of the company.
Independent Director	A director is independent if he/she is declared to be independent in Corporation Governance Statement and does not have any of the relationships in Box 2.1 of Corporate Governance Principles and Recommendations 2nd Edition (ASX Corporate Governance Council); this concept applies only to directors.
Qualification details	Qualifications a director/executive has; please note this is field has been updated over time (e.g. if T Smith received his PhD in 2010, his existing qualification would be updated to include it. PhD would appear in post-2010 years as well as pre-2010 years.
Year of birth	Financial year deducted by an individual's age.
Date of appointment	The appointment date for an individual's first role in a company; where exact appointment date is accurate to a month or year, the first day of the month or year is used; where no appointment date has been reported, 1/1/1901 is the default date.
Date of resignation	The resignation date for an individual's last position in a company; where exact resignation date is accurate to a month or year, the first day of the month or year is used; where no resignation date has been reported, the field is left blank
Board Meetings attended while as a Director	The number of board meetings attended while this person has been a director, in the current annual report. Can include some records where executives or incoming directors have been invited.
Gender	Gender of the director.

Appendix 11: Detail Analysis Of The First Stage Regression Results Of Two-Stage Least Square Estimation

	Dependent Variable: PFOB				
Regressor	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**[95% Conf.]**
Board	0.086	0.208	0.41	0.68	-0.32
PIndDir	0.126	0.022	5.54	0	0.081
CEOT	0.153	0.109	1.4	0.162	-0.06
CEODua	1.517	2.111	0.72	0.473	-2.63
LogMC	0.835	0.736	1.13	0.257	-0.61
LogRev	-0.00	0.230	-0.04	0.97	-0.46
NDE	-0.00	0.001	-1.01	0.312	-0.00
VROE	0.004	0.007	0.59	0.553	-0.01
FC	0.136	0.025	5.32	0	0.085
#of Observation		1981			
R^2		0.1019			

Note to Appendix 11:

Appendix 11 presents the first stage regression results using the selected external instrumental variable as the dependent variable. Column 1 tabulates the variable of interest and control variables to examine the relationship between the endogenous variable with the selected instrumental variable, the proportion of local female councillors (FC). The first stage regression and the second stage regression are:

1st stage regression: $GD_{it} = \alpha_0 + \alpha_1 FC + \alpha_k CV_{it} + v_{it}$

2nd stage regression: $P_{it} = \beta_0 + \beta \widehat{GD}_{it} + \beta_k CV_{it} + \varepsilon_{it}$

Where: $\widehat{GD}$ *is the predicted value of the gender diversity measure after taking into consideration of the external instrumental variable.*

The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The regression results are adjusted for potential heteroskedasticity with variance robustness check. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |t| or Prob > |z| for the first stage instrumental regression of 2SLS fixed effects estimation.

Appendix 12: Comparison of Regression Analysis Between Dataset Without Winsorising and Dataset With Winsorising at 1% Level

Explanatory Variables	Regression Analysis without Winsorising of Dataset					Regression Analysis with Winsorising of 1% Dataset				
	Dependent Variable - Log Q					Dependent Variable - Log Q				
	OLS-RE	OLS-FE	2SLS (IV)	Diff' GMM	Syst GMM	OLS-RE	OLS-FE	2SLS (IV)	Diff' GMM	Syst GMM
Gender Diversity (GD)	-0.0017***	-0.0016***	-0.0029	0.0091	0.0027	-0.0166***	-0.0016***	-0.0029	-0.0097	0.0017
Board Size (LogQ)	-0.0291***	-0.0212***	-0.0211***	-0.1398	-0.1032*	-0.0289***	-0.0212***	-0.0211***	-0.0912	-0.109*
Proportion of Independent Directors (PIndDir)	-0.0022***	-0.0018***	-0.0016***	-0.0136	-0.0061	-0.0022***	-0.0018***	-0.0016***	-0.0051	-0.0065
CEO Tenure (CEOT)	0.0009	-0.0035	-0.0033	0.0309	0.0168	0.0009	-0.0034	-0.0032	0.0221	0.0181
CEO Duality (CEODua)	-0.042	-0.0636	-0.0618	0.5	0.6611	-0.0433	-0.0647	-0.0629	0.4396	0.5602
Market Capitalisation (LogMC)	0.3115***	0.3530***	0.3545***	0.4752	0.2719**	0.3092***	0.3518***	0.3545***	0.4927**	0.2799**
Total Revenue (LogRev)	-0.0763***	-0.0742***	-0.0742***	-0.0922	-0.0363	-0.0745***	-0.0734***	-0.0742***	-0.0706	-0.0354
Gearing Ratio (NDE)	-0.00004	-0.00001	-0.00001	-0.0015	-0.0005	-0.0002**	-0.00001	0.0001	-0.00006	0.0001
Volatility (VROE)	0.0022***	0.0021***	0.0021***	0.004	0.0066*	0.0022***	0.0021**	0.0021**	0.0022	0.0066*
Lag 1 of Log Q				0.4198	0.267*				0.3902	0.2809*
# of observations	1981	1981	1981	1393	1682	1981	1981	1981	1393	1682
# of instruments				13	26				13	26
R^2	0.4026	0.4138	0.4112			0.4043	0.415	0.4125		
AR(1) Test p-value				0.445	0.1				0.06	0.002
AR(2) Test p-value				0.48	0.54				0.3	0.65
Hansen Test of over-identification (p-value)				0.8	0.43				0.26	0.42
Difference-in-Hansen tests of exogeneity (p-value)				0.41	0.25				0.66	0.19

Note to Appendix 12:

Appendix 12 presents the comparison of regression analysis between the dataset without winsorising and the dataset with winsorising at 1% level. Column (2) to (6) presents the analysis results of OLS random effects, fixed effects, 2SLS, differenced GMM and system GMM estimations based on original dataset without winsorising. Column (7) to (11) presents the analysis results of OLS random effects, fixed effects, 2SLS, differenced GMM and system GMM estimations based on 1% winsorising of dataset. The sample consists of an unbalanced panel data of 299 companies with 1981 firm-year observations for the period from 2008 to 2015. The regression results are adjusted for potential heteroskedasticity with variance robustness check. The asterisks represent the significance of critical value at 0.01 (***), 0.05 (**) and 0.10 (*) of Prob > |t| or Prob > |z|. The comparison results show no significant difference between the two sets of data.

Appendix 13: Sample of GMM Stata Output

Dynamic panel-data estimation, two-step difference GMM

Group variable: Companynum — Number of obs = 1393
Time variable : Yearnum — Number of groups = 273
Number of instruments = 13 — Obs per group: min = 0
F(10, 273) = 2.90 — avg = 5.10
Prob > F = 0.002 — max = 6

LogQ	Coef.	Corrected Std. Err.	t	P>|t|	[95% Conf.	Interval]
L1.	0.4198126	0.3004654	1.4	0.163	-0.171711	1.011336
PFOB	0.0091069	0.0342343	0.27	0.79	-0.05829	0.0765037
Board	-0.1398422	0.1094769	-1.28	0.203	-0.355368	0.075684
PIndDir	-0.0136321	0.0155202	-0.88	0.381	-0.044186	0.0169223
CEOT	0.0308632	0.0317184	0.97	0.331	-0.031580	0.0933069
CEODua	0.4999584	0.7496023	0.67	0.505	-0.975777	1.975694
LogMC	0.4752049	0.3183938	1.49	0.137	-0.151614	1.102024
LogRev	-0.0922438	0.1173336	-0.79	0.432	-0.323237	0.1387499
NDE	-0.0015105	0.0026428	-0.57	0.568	-0.006713	0.0036924
VROE	0.0040269	0.0057967	0.69	0.488	-0.007385	0.0154388

Instruments for first differences equation
Standard D.FC
GMM-type (missing=0, separate instruments for each period unless collapsed)
L2.(LogQ PFOB)

Arellano-Bond test for AR(1) in first differences: z = -0.76 Pr > z = 0.445
Arellano-Bond test for AR(2) in first differences: z = -0.71 Pr > z = 0.476

Sargan test of overid. restrictions: chi2(3) = 0.31 Prob > chi2 = 0.959
(Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(3) = 1.03 Prob > chi2 = 0.795
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets: IV(FC)
Hansen test excluding group: chi2(2) = 0.35 Prob > chi2 = 0.838
Difference (null H = exogenous): chi2(1) = 0.67 Prob > chi2 = 0.412